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ABSTRACT

This study attempted to investigate the effects of school experience on visual perception tests involving line figures and forms. There were two experiments in this study. Experiment 1 examined the independent and interactive influences of school experience and chronological age in kindergarten children. Experiment 2 compared the effects of kindergarten and first grade curricula on performance on visual perception tests. In experiment 2, a test-retest design was used with kindergarten and first grade children whose birthdays were close to the December 1 cut-off date, so that the two groups were less than one month apart in age. The tests used were the Developmental Test of Visual Perception, the Visual Memory Test, the Visual Motor Gestalt Test, the Visual Sequential Memory subtest of the Illinois Test of Psycholinguistic Abilities, the Southern California Figure-Ground Visual Perception Test, and the Visual III from the Reading Aptitude Tests. The results of experiment 2 suggested that the interaction effects indicated a greater change in six months for the kindergarten children in comparison to the first grade children. Also, the present normative groups based on age penalize the child who is among the older children in his grade. (WR)

Age, School Experience and the Development of Visual-Perceptual Memory

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INTRODUCTION

The development of visual perceptual skills are of considerable interest to educators. Certain visual skills (along with auditory skills) have been postulated to be essential to beginning reading. For example, Spache and Spache (1969) end a discussion of visual perceptual skills by saying: "Reading is first and foremost a visual task for the beginning reader and almost impossible for him to accomplish without the perceptual and discriminative abilities we have stressed" (page 199). Furthermore, a number of studies (e.g., Barrett, 1965a; Goins, 1958; Monroe, 1935) have found moderate correlations between different tests of visual skills and first grade reading achievement. Studies involving children from grade three on (e.g., Phelan, 1940) have found little correlation between visual perception test scores and reading achievement.

There is no common agreement as to whether there are discrete visual perceptual skills which develop independently or whether there is a single unitary set of skills used in processing visual input. Nevertheless, visual discrimination skills, such as the ability to detect and respond to differences in characteristics such as form, are almost invariably included in the skills meant when a test is labeled "a test of visual perceptual skills." Less commonly, the cognitive skills needed to give meaning to visual stimuli are included in the term.

Reading readiness tests also contain a variety of tasks which are used to determine if a child has the skills needed to learn to read. A large proportion of the tasks on these tests involve visual discrimination skills, e.g., matching words to a sample, marking the picture that is different in a group, etc. Statistically, the best predictor of first grade reading success is the ability to name letters. However, educators, e.g. Barrett (1965a) have viewed this particular task as being strongly influenced by environmental factors and have sought to develop tests using pictures, forms, etc. which reflect the "potential to learn to read" more than achievement.

Tests have also been devised for use with children who are having difficulties in school. These tests, e.g., the Developmental Test of Visual Perception (Frostig, 1961), the Southern California Figure-Ground Visual Perception Test (Ayres, 1966), purport to measure different visual skills postulated to be important for school achievement. Each test or subtest attempts to focus on one particular skill (as defined by the test author).

Both reading readiness tests and visual perception tests are concerned with the skills needed for academic achievement and often contain very similar items. The readiness tests are more likely to use letters or words as stimuli and the visual perception tests typically involve geometric forms or pictures. However, the task demands, such as matching on the basis of certain physical characteristics or copying the sample, are the same for both the readiness and perception tests even though these two types of tests have quite different norm standards. On a readiness test, the child is ranked in comparison to other children of the same grade placement regardless of chronological age. On the "diagnostic" visual perception tests, the child is ranked in terms of children of the same chronological age regardless of the amount of school experience. In both instances, as much as a whole year variation in terms of the other variables not considered is possible. The question arises as to whether either normative group selected on only one factor (either school experience or chronological age) is appropriate and if so, which one.

In the reports of the normative data for the visual perception tests the mean scores differ by several points for children of different age groups (generally three or six month intervals) but the standard deviations within each age group tend to be fairly large. Often the differences in the mean scores for children a year or more different in age are less than one standard deviation. None of the existing tests of visual perception skills have grade placement norms so the degree of overlap between children with known differences in school experience cannot be examined.

Most kindergarten and first grade curricula contain a variety of activities designed to foster the development of visual skills. If these activities are effective, the amount of school experience, i.e. the exposure to such activities over an academic year should affect performance on visual perception tests. On the other hand, if factors related to physical maturation (i.e. neural development) are primarily responsible for the development of visual perceptual skills, the effects of school experience (with age controlled) on such skills should be limited. No study could be found which examined the influences of these two factors.

In terms of the role of school experience there is a dilemma. If school experience is an important factor in the development of visual perceptual skills, how likely are we to make incorrect decisions with norms based on chronological age? Furthermore, if school experience facilitates the development of such skills we need to know what kinds of experiences are most effective. If school experience is not important in the development of visual perceptual skills the time now spent on activities designed to foster development of visual perceptual skills could be better spent on other activities.

This study attempted to investigate the effects of school experience on performance on visual perception tests involving line figures and forms. In Experiment I, groups of kindergarten children matched on age or school experience were used to examine the independent and interactive influences of each factor. In Experiment II, comparisons were made of the effects of kindergarten and first grade curricula on test performance with chronological age controlled.

REVIEW OF THE LITERATURE

Age and School Experience

Relatively few studies have been designed to examine the effects of age-related influences on performance independent of those of school experience. In studies concerned with school achievement, children are generally tested at the same point in time (usually the end of the school year). This keeps the amount of school experience constant within each grade but allows a twelve month variation in chronological age within each grade.

Differences in the performance by children of the same age who were born at different times of the year have been noted for some time (e.g., Fialkin and Beckman, 1938; Goodenough, 1940; Huntington, 1938; Lodge, 1938; Mills, 1941; Pinter and Forlano, 1933). A number of the studies have focused on the relationship between the performance on intelligence tests and the time of year that the child was born (e.g., Craddick, 1966; Orme, 1963; Williams, 1964). The majority of these studies have found statistically significant correlations between intelligence test scores and the season of birth. However, the season of the year in which the highest mean scores occurred has differed from study to study. For example, Craddick (1966), administering the Wechsler Intelligence Scale for Children and the Wechsler Adult Intelligence Scale to normal adults and children, found higher IQ scores for the groups in his sample that were born in the winter or spring. Orme (1963) had found the IQ of a sample of mentally retarded adults was higher if they had been born in the summer or fall. The authors of most of the studies in the 1930's and 1940's suggested that the important factors in these seasonal IQ differences were conditions such as the climate that occurred during pregnancy.

Williams (1964), in a review of the studies on the relationship of season of birth and intelligence test scores has suggested two possible school-related factors in the different test performance of children born in different seasons: length of school and the child's age position in his group in school. Since the studies were performed in different countries which had varying patterns of school organization and entrance ages, the influences of these two factors could be different in the different studies.

Using a cross-sequential design in which children of three different ages (8:0, 9:0, 10:0) were measured at three different times of the year, Baltes, Baltes, and Reinert (1970) found a significant effect of time of measurement (with age controlled) on four intelligence test subtests: inductions, verbal comprehension, numerical facility, and perceptual speed. This difference seen in the same age children tested at different times of the year was interpreted as due to differential amounts of schooling.

There continues to be some disagreement as to the relationship of chronological age to school performance. Some of the studies conducted in England (e.g., Jinks, 1964) have shown a correlation between age and school performance but the structure of their school system is such that children born at different seasons of the year would have different length of schooling in the Infant Schools. A child enters Infant School at the first of the three entrance dates during the year after he becomes five years old. However, the entire year's group moves into Junior School as a unit after three years so that children born in certain months will enter Junior School with only two and a third rather than three full years in Infant School.

Studies conducted in the United States have found moderate positive correlations between entrance age and school achievement if the achievement testing was done after the primary grade level. However, most of the studies (e.g., Carter, 1956; Dickinson and Larson, 1963; Hall, 1963; King, 1962; Miller and Norris, 1967) have used children admitted to school when either younger or older than the usual age for the comparison groups rather than different ages within the normal one year span of ages created by the cut-off dates for school admission. No studies were found that showed a significant correlation between admission age and achievement in the later grades when the age range was restricted to the one year age span.

Of greater interest to the present study is the fact that the correlation between chronological age and first- or second-grade reading skills has repeatedly been found to be negligible (Barrett, 1965a; Hirst, 1970; Petty, 1939). Murray (1966) found higher correlations between first grade reading achievement and all the visual-motor-perceptual tests he administered, i.e. the Winterhaven Form Copying Test and Monroe Visual I and III, than between chronological age and reading achievement. There have been some studies (e.g., Rosenthal, 1969) showing a low but statistically significant positive correlation between chronological age and scores of readiness tests such as the Lee-Clark Reading Readiness Test (Lee and Clark, 1962) administered to kindergarten children.

There appears to be little evidence indicating that chronological age, at least within a twelve month span, is highly correlated to academic achievement. Rather the amount of school experience is considered as the most important influence and this is reflected in the grade placement grouping of the normative data for achievement tests.

In contrast, tests of visual perceptual skills have age norms. Such a basis for establishing norms would seem to imply that the test authors thought that chronological age was more important than school experience in determining performance on such tests. The normative data for such tests (e.g., Ayres, 1966; Koppitz, 1964) do show differences in the mean scores for groups of children where the mean chronological age differs by at least six months. Unfortunately, the data reported in these studies do not include an indication of the testing dates. Without knowing the period of time during which testing was carried out it is impossible to calculate the correlation between chronological age and the amount of school experience that existed in the normative sample. If all ages of children were tested within a short period of time, say one month, the relationship between chronological age and school experience would be different than if testing was distributed throughout the calendar year.

Table 1 presents the difference in the relationship between age and school experience if all the testing was done in a single month such as May or November in contrast to the testing being spread throughout the year. If the cut-off date for entrance into school is December 1 then in May seven year olds with birthdays from December to May would be in first grade while seven year olds whose birthdays are in June to

Table 1

The Relationship Between Age and Average School Experience in Seven Year Old Children Tested at Different Times of the Year

Chronological age	November only	May only	Throughout year
7-0	1.3	.9	.8
7-1	1.3	.9	.9
7-2	1.3	.9	1.0
7-3	1.3	.9	1.0
7-4	1.3	.9	1.0
7-5	1.3	.9	1.1
7-6	1.3	1.9	1.2
7-7	1.3	1.9	1.3
7-8	1.3	1.9	1.4
7-9	1.3	1.9	1.5
7-10	1.3	1.9	1.6
7-11	1.3	1.9	1.7

November would be in second grade. As a result children with ages of 7-0 to 7-5 when tested in May would have had .9 years of school experience and children who are 7-6 to 7-11 would have had a whole additional year of school experience or 1.9 years. If school experiences were an important factor in performance on the test, the mean scores for these two age groups might be very different. If, however, the testing was done in November all seven-year-olds would be in the second grade and the year difference would be between six and seven year old or seven and eight year old children rather than at the half year mark. If the testing is spread throughout the year this time of testing effect due to school experience will be spread throughout the age range rather than creating sharp dividing points.

Regardless of the distribution of testing dates there would be a positive correlation between chronological age and school experience with a larger correlation the greater the spread of testing times. Within the ages where the child might be attending either a structured pre-school or elementary school setting there exists the possibility that school experience could account for a significant portion of the difference in scores in different age groups.

Within the elementary school setting, visual discrimination and memory of letters and words are taught. However, the question looms as to whether the training with letters would affect the ability to discriminate and remember other visual stimuli such as pictures and forms. There is evidence that form discrimination can be improved by specific training on such skills. Studies using materials such as the Frostig Remediation Program, a series of 359 work sheets (Frostig and Horne,

1964) have shown changes in scores on reading achievement tests as well as on the Developmental Test of Visual Perception (Frostig, 1961) which measures the same skills trained in the remediation program (Rosen, 1966; Wheelock, 1968; Williams, 1968).

Most of the reading readiness programs contain activities designed to train visual discrimination of stimuli such as forms varying on various dimensions. By implication, the training on these stimuli prepares the children for the finer discriminations involved in learning to distinguish between different letters of the alphabet.

Tasks involving discrimination of geometric forms can be varied so that the amount of difference between stimuli is either greater or less than between letters. No studies could be found that investigated the effect of letter discrimination on the more difficult of the form discrimination tasks. Since most visual perception tests are designed to be used up to the ages of eight to ten they include some fairly difficult items.

It is likely that there is a positive relationship between the skills involved in the discrimination and memory of letters and the skills involved in the discrimination and memory of geometric forms. Whether there is a sufficient relationship for letter training to significantly affect performance of visual perception tests which use forms is not known.

Types of Visual Perceptual Skills

The term "visual perceptual skills" encompasses a wide variety of skills. In the broadest sense it would include all skills involved in giving meaning to any type of visual stimuli. However, meaning is not really involved in many of the tasks used in standardized tests concerned with visual perception skills. Many tasks involved in the visual perception tests [illegible]ly require the detection of similarities or differences in physical properties such as orientation in space, a class of skills more properly titled visual discrimination (Fellows, 1968; Vernon, 1970). To be sure, discrimination is necessary before accurate meaning can be given to a visual stimulus but discrimination is only part of the process of visual perception. The skills covered by this study involved forms as forms, not as symbols having meaning, so the term "visual perceptual skills" is not necessarily the most accurate one to use. However, as the test names will suggest, this term has been used to cover skills, such as visual discrimination, which are involved in visual perception, thus the term will be used as a general term.

The available standardized visual perception tests were devised primarily to measure only those skills thought to be related to academic performance. As a result only a small portion of the range of visual perception skills is sampled. For example, skills such as those required in making color or size discriminations are not included in the tests.

Psychologists studying visual perception have included a much wider variety of tasks, both in the dimensions on which the stimulus is varied and the nature of the decision which must be made about the stimulus. For example, Hake (1966) has described five types of decisions involved in perception:

1. detectibility -- is there a stimulus present or not?

2. discrimination -- is the stimulus different from a standard?

3. identification -- which stimulus is present?

4. recognition -- has this stimulus been seen before?

5. judgmental -- what scale value should be assigned to this stimulus?

Another dimension is the time available to perform the task; i.e. whether unlimited time is allowed or whether speed is a factor.

When meaningful stimuli (such as pictures or words) are used in a task, a variety of additional cognitive skills may also be involved. For example, matching words on a conceptual basis would appear to be more closely related to matching pictures on a conceptual basis than to matching words on the basis of their physical characteristics. Several studies using visual perception tasks (e.g., Gates, 1940; Sister Mary of the Visitation, 1929) have found tasks to correlate more highly with each other when the stimulus material, e.g., words versus forms, was the same and the task different than in the reverse situation. For example, the scores on a match-to-sample test using words as stimuli correlated more highly with the same-different pair judgment word scores than with scores on a match-to-sample test using groups of digits. However, the range of tasks used in these studies was quite small. In the study by Sister Mary of the Visitation (1929) there were only three types of tasks: match-to-sample, same-different judgment of pairs of stimuli, and one task which required finding which group of letters spelled a common word. Four types of stimuli were used: words, groups of letters, groups of digits, and designs.

Within the limited range of tasks used in the more common tests of visual perceptual skills, there have been questions raised whether an individual's repertoire is characterized by specific skills or only one general visual perceptual factor. Factor analytic studies of tests such as the Developmental Test of Visual Perception which has five subtests (e.g., figure ground discrimination, position of figures in space) have failed to find any consistent discrete factors (Ohnmacht and Olson, 1968; Ward, 1970).

The stimuli used in the present study were geometric forms (line drawings) used strictly as forms and not as meaningful symbols. Responses included indicating a matching or odd stimulus by pointing (or tracing) and drawing (or constructing) a reproduction. On some of the tests the child's response is made after the stimulus has been displayed for a controlled period of time and then removed, which requires not only discrimination but memory skills.

Tests of Visual Perception Skills

There are a large number of tasks which could be considered to involve visual perception skills. This study focused on the discrimination of two dimensional forms. This decision eliminated tests or subtests involving three-dimensional objects or other visually-detected attributes such as color or size. Also omitted were tests involving meaningful pictures such as the Picture Completion and Objects Assembly subtests of the Wechsler Intelligence Test for Children (Wechsler, 1949), the Visual Association subtest of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, and Kirk, 1968), or tests using letters or words such as the Matching subtest of the Lee-Clark Reading Readiness Test (Lee and Clark, 1962) or the Memory for Letters subtest of the Detroit Tests of Learning Aptitude (Baker and Leland, 1967).

There are several tests which require the copying of geometric forms while the stimulus is present. Perhaps the best known of these tests is the Bender Visual Motor Gestalt Test (Bender, 1938). This test uses nine geometric designs which are presented one at a time for the child to copy on a plain sheet of paper. Some of the designs are line drawings, others are constructed of dots. Although this test is also used as a projective technique, there are developmental changes in performance (e.g., in the accuracy of reproduction) up to the age of 10 or 11. There are several available scoring systems for the Visual Motor Gestalt Test (Bender Gestalt). Koppitz (1964) has devised a developmental scale reflecting distortions related to immaturity with norms given for ages between five and ten years. There are 30 mutually exclusive scoring items (from two to four per design) which are scored as present or absent. Scoring categories include distortion of shape, rotation, perseveration, and integration.

A more recent test in this area is the Developmental Test of Visual-Motor Integration (Beery, 1967) which has 24 figures to be copied in spaces in a test booklet. All figures are line drawings beginning with single lines and progressing through simple geometric figures such as a circle to figures involving diagonals and several overlapping figures. The figures range from being more simple to more complex than those used in the Bender Gestalt and the norms extend from age two to fifteen. Each form is scored on a pass-fail basis and not on specific errors. Three factors made this test less desirable than the Bender Gestalt for this study; the limited number of figures that would discriminate within the restricted age range in this study, the pass-fail scoring system, and the cost of the test booklets.

One section of the Perceptual Forms Test sponsored by the Winter Haven Lions Club (1960) requires the copying of geometric figures such as a circle and diamond. This test has different forms for kindergarten and first grade children which made it unsuitable for Experiment II of this study.

The Copy Forms test used by the Gesell Institute (Ilg and Ames, 1964) involves the copying of six geometric figures and the drawing of two three-dimensional objects. Both the inclusion of the three-dimensional forms and the scoring system made this test unsuitable. Scoring for this test is largely qualitative and descriptive.

The Dennis Visual Perception Scale (Dennis and Dennis, 1971) has 20 designs to be copied on fields of small squares. This test was not available at the time this study was begun.

Subtest V (Spatial Relations) of the Developmental Test of Visual Perception (Frostig, 1961) requires the reproduction of seven or eight figures composed of straight lines drawn between pairs of dots. This test was included in the study.

The greatest majority of visual memory tests require the reproduction of a stimulus containing one or more figures after exposure for a brief interval of time (usually 5 to 10 seconds). However, most of these tests have not been found satisfactory for use with children under the age of eight. Such tests include the Benton Visual Retention Test for

Clinical Use (Benton, 1946), the Graham-Kendall Memory-for-Designs Test (Graham and Kendall, 1960), and the Ellis Visual Designs Test (Lord and Wood, 1942). There are two tests which have been used successfully with young, school-age children. One is the Visual III subtest of the Monroe Reading Aptitude Tests (Monroe, 1935). This test has four cards with four line figures to a card. Each card is exposed for 10 seconds and then the child is asked to reproduce all the pictures that he can remember from that card. New norms have been established by the Gesell Institute (Ilg and Ames, 1964). The Memory for Designs subtest of the Detroit Tests of Learning Aptitude (Baker and Leland, 1959) requires both the drawing and completion of forms . the test booklet used for the entire battery of tests. It appeared that this test would not give sufficient additional information in comparison to the Visual III subtest to justify the cost of the test booklets which would be used for that subtest only.

Visual memory tests with responses other than drawing of the stimulus are not as common. The Visual Sequential Memory subtest of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, and Kirk, 1968) requires the reconstruction of sequences of two to eight chips with nonmeaningful designs. The Chicago Test of Visual Discrimination (Weiner, 1968) is a multiple-choice test using designs from the Bender Gestalt Test and the Graham-Kendall Memory-for-Designs Test and is given both as a memory and matching test. Since the Bender Gestalt Test was being used in this study the forms would be familiar if the Chicago Test of Visual Discrimination was also used. Since a multiple-choice visual memory test was desired for this study as a contrast for both Visual III (a memory test requiring drawing) and the other multiple-choice tests, the author devised the Visual Memory test which is a 30 item test using letter-like forms. The choice forms vary from the sample on the same dimensions that letters differ from each other, such as rotation or the addition of elements.

Only two tests specifically testing the ability to discriminate a figure from its background could be found which were suitable for use with young children. One was the Southern California Figure-Ground Visual Perception Test (Ayres, 1966) which is a multiple choice test. The stimulus plates involve both overlapping and embedded figures and the child is allowed one minute to choose the three of the six choice figures that are in the stimulus plate. The second figure-ground test is the Figure-Ground subtest of the Developmental Test of Visual Perception (Frostig, 1961) which involves tracing over specified overlapping figures. There are some other tests which are closely related such as the Form Constancy subtest of the Developmental Test of Visual Perception (Frostig) which requires discrimination of a particular geometric form regardless of its size or surroundings. The Visual Closure Test of the Illinois Test of Psycholinguistic Abilities (ITPA) involves locating only partially depicted objects in a complex scene. Tests such as the Street Gestalt Test used by Goins (1958) and the Visual Automatic Test devised by Kass (1962) which requires the naming of objects whose silhouette or outline has a number of areas missing probably have a strong figure-ground component. These last three tests involve pictures rather than non-meaningful figures.

Tasks requiring the matching of a sample or choosing the odd figure strictly on the basis of physical characteristics tend to show a strong ceiling effect at six to seven years unless the figures used are very complex. The Position in Space subtest of Developmental Test of Visual Perception (Frostig) requires either matching or choosing the odd picture on the basis of the position of all or parts of the figure. A number of items on the Visual Memory Test (Wood, 1971) contain choices that are rotated or reversed versions of the standard. The battery of tests used by Goins (1958) included several tests involving matching on various physical dimensions but these tests used letters or pictures. Tests involving match-to-sample tasks for school age children have generally involved meaning or conceptual relationships as the basis for matching rather than physical similarity. Two examples would be the Visual Reception and Visual Association subtests of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, and Kirk, 1968) which use photographs or outline drawings of objects. The child must choose the objects which are conceptually similar or related.

There have been questions raised as to whether there really are a number of discrete visual perception skills. The results of the various studies differ. Ayres (1966) has found relatively low correlations (.12 and .38) between the Southern California Figure-Ground Visual Perception Test and Figure-Ground subtest of the Developmental Test of Visual Perception (Frostig, 1961) that supposedly measure the same skill, i.e., figure-ground discrimination. O'Connor (1969) found product moment correlations of .63 between the Frostig and the Bender Gestalt and .62 between the Frostig and the Harrison Reading Readiness Test. A canonical analysis of the Developmental Test of Visual Perception (Frostig), the Metropolitan Reading Readiness Test and the Gates Reading Readiness Test found them to possess an underlying common perceptual function (Ohnmacht and Olson, 1968). Corah and Powell (1963) found the intercorrelations with the Frostig to vary from .18 to .57. However, factor analytic studies of the Frostig (e.g., Olson, 1968; Ward, 1970) have found the five subtests to possess a single common perceptual factor.

Intelligence tests often contain items requiring visual discrimination or memory skills. Memory items on the Stanford Binet Intelligence Scale (Terman and Merrill, 1960) include such tasks as reproducing a bead chain, finding a matching picture after the stimulus is removed, and reproducing a design exposed for 10 seconds. The Detroit Tests of Learning Aptitude (Baker and Leland, 1967) include subtests that require the naming of pictures or letters from memory plus a subtest requiring the reproduction or completion of designs after the stimulus is exposed for 10 seconds. Other visual discrimination tasks include such items as Pictorial Similarities and Differences on the Stanford Binet Intelligence Scale and Picture Completion subtest on the Wechsler Intelligence Scale for Children. The Wechsler Intelligence Scale for Children contains maze items which require visual as well as motor skills. There are a number of other items that require visual discrimination skills in addition to a variety of cognitive skills.

Another major category of tests containing visual discrimination and memory items is that of the reading readiness tests (e.g., Metropolitan Readiness Tests, Reading Aptitude Tests, Lee-Clark Reading Readiness Test). Although verbal materials such as words or letters may be used, many of the subtests use them as forms rather than symbols in tasks such as match-to-sample which only require detecting similarities or differences on the physical characteristics of the stimuli.

Visual Perception Skills and Academic Achievement

As is reflected in the inclusion of visual tasks in the reading readiness tests, educators have believed for some time that visual discrimination skills are important in the development of reading skill (e.g., Bond and Wagner, 1950; Gates, 1937; Gray, 1925; Tinker, 1929; Vernon, 1959). Intuitively, the ability to discriminate between different visual forms and to remember those forms seems essential to learning to match sounds with letters and words. Barrett (1969) describes the three major current views of reading as: reading as decoding, reading as involving perception and cognition, and reading as involving perceptual, cognitive, and affective responses. According to all three views, reading requires sufficient visual perceptual skills to distinguish letters and words. Vernon (1959) describes these skills as involving the perception of "small meaningless shapes containing a good deal of detail." He describes the child as having particular problems with the orientation of shapes and the order of shapes in a sequence. Betts (1948), for example, sums up the opinion of a number of educators when he says "The ability to be a good observer of the likenesses and differences among word forms appears to be an important factor in reading ... In short, the ability to make visual discriminations among word forms generally is conceded to be basic to readiness for initial instruction in reading" (page 220). DeBoer and Dallman (1964) after describing the importance of visual perception go on to say "Improvement in making such discriminations can be brought about through training" (page 68).

A variety of visual discrimination tests have been developed in an effort to predict readiness to read and the probability of success in learning to read. Educators would like to be able to measure when a child is "ready" to learn to read so that instruction is not started too soon or delayed too long. For the children who are not yet ready, but because of chronological age are in the first grade, they want to know what essential skills the child lacks so that appropriate training can be provided.

Barrett (1965a) has provided an excellent review of studies measuring visual discrimination at the beginning of first grade and reading achievement later in first grade. Of the various tasks used to predict reading readiness, naming letters shows the highest correlation with reading achievement (Barrett, 1965a). This particular skill, however, is extremely dependent on the child's environment (e.g., Dunn, 1959). Letter names have to be taught, i.e. the child cannot discover the names of letters without assistance. For this reason, many educators have thought that other tasks, particularly those using nonverbal materials gave a better indication of the child's "potential" ability to learn to read. Supposedly, this type of task does not penalize children from different cultural or socio-economic groups.

Different studies have found somewhat different visual perception tasks to have the highest correlation with performance on a reading test. At the first grade level visual discrimination tests tend to have a higher correlation with reading performance than chronological age or intelligence (e.g., Bryan, 1964; Petty, 1939). This relationship appears to decrease with age and generally by the third or fourth grade nonsignificant correlations between scores on visual discrimination tests and reading achievement tests are the rule (Bryan, 1964; Phelan, 1940; Sister Mary of the Visitation, 1929).

Where both tests using letter or words as stimuli and tests using digits or pictures have been used in the same study, the tests using words or letters generally show a higher correlation with reading tests (e.g., Ashlock, 1965; Goins, 1958). However, there have been tests using forms or pictures as stimuli with correlations of .47 to .60 with reading achievement tests (e.g., Goins, 1958; Keogh, 1963; Monroe, 1935; Murray, 1966; Potter, 1959). The highest correlations have tended to occur when the test required copying the figure instead of other tasks such as matching (Barrett, 1965a).

Particular stress has been placed by some authors on the ability to discriminate changes in spatial orientation. Silver and Hagin (1970) state that: "In our experience 80% of the children with reading disabilities have difficulty with the orientation of visual stimuli in space. This is at a level of visual recognition and does not involve verbal symbols" (p. 448). Wechsler and Hagin (1964) found a correlation of .43 between the Lamb Chop Test (involves judging the position of a figure shaped like a lamb chop) and first grade reading readiness scores. When Silver and Hagin (1970) retested 18 reading disability cases 10 years later, these individuals still showed problems in orientation of figures in space and figure-ground relationships.

Two studies suggest that the format of the test and its relationship to procedures used in classroom reading instruction might be important. Keogh (1963) found higher correlations between the Bender Gestalt and first grade reading when the Bender Gestalt was administered to a group using large cards held up in the front of the room. Gates (1940) found that a word-card matching test in which the stimulus was exposed on a card for a short period of time and then removed made a significant contribution to the predictive value of the Gates Reading Readiness Tests quite independent of the predictive value of the word matching tests which left the stimulus exposed for comparison.

PROBLEM

Research Design

There are two parts to this study: Experiment I was designed to examine the effects of age and school experience on performance. Experiment II was designed to evaluate the effect of different school experience with age controlled.

Experiment I

In this part of the study it was essential to separate the effects of age from those of school experience. For this reason, a number of the usual research designs were not suitable. In cross-sectional studies where children of various ages are tested at one point in time, age and school experience cannot be separated. That is, the amount of school experience is held constant within each grade level but age and school experience differ across grades. To control for this confounding, cross-sectional sampling needs to be done at more than one testing time. Similarly in a conventional longitudinal design, as a child increases in age he also increases in amount of school experience so the effects of the two factors also cannot be determined separately.

Schaie (1965) has proposed some sequential paradigms which permit independent analysis of at least two of the three sources of developmental change: age, cohort, and time of measurement. In his designs age represents changes in an individual over time, cohort represents the changes between generations, and time of measurement relates to changes in the environment between times of measurement. In this study, which involved a fairly short time period with school-age children, these factors still existed but had somewhat different implications. Children born within six months of each other probably will not reflect much of a difference due to genetic or cultural differences. However, they will have differences in their grade placement at any given age. Time of measurement, as defined here, will reflect the amount of school experience.

The time-sequential method outlined by Schaie (1965) permits inferences as to age differences as well as differences related to the time of measurement. There is also an estimate of the interaction of age and time of measurement which is confounded with cohort differences. In this instance it was assumed that there were no significant cohort differences due to genetic or out of school environmental differences when the cohorts were not separated by more than one year. This type of design (Table 2) requires measurement of each of several age groups at several times of measurement.

Table 2

Time Sequential Design

	Time of measurement	
Age at time of testing	October	April
Younger	A	C
Older	B	D

Such a design permits comparison of groups that are the same age with a group of different age but with the same amount of school experience with:

$$\text{Age differences} = \frac{A + C - B - D}{2}.$$

Also groups with the same amount of school experience can be compared with groups that are the same age when tested but have a different amount of school experience with:

$$\text{Time differences} = \frac{A + B - C - D}{2}.$$

In addition, representatives of the same cohort are tested at each of the two times. This can be compared to groups of different cohorts which match on one of the factors.

$$\text{Interaction} = \frac{A + D - C - B}{2}$$

Experiment I used the same sequential design and kindergarten children. There were independent samples of two age groups, 5 years and 4 months and 5 years 10 months, tested at each of two testing times, October and April. An analysis of variance was used to evaluate the results.

Experiment II

A second design proposed by Schaie, the cross-sequential design, was also adapted for use in the present study. The cross sequential design involves the factorial manipulation of cohort and time of measurement. The cohort variable was of special interest here because of school regulations regarding a child's birthdate and admission to school. That is, it was possible to choose samples of children who were matched on chronological age but who, nevertheless, differed in school experience by a complete year. The cross-sequential design is schematized in Table 3.

Table 3

Cross Sequential Design

	Time of measurement	
Cohort	October	April
Pre cut-off birthdate	E	E'
Post cut-off birthdate	F	F'

The design permits comparison of groups of children that are the same age but who differ in grade placement with:

$$\text{Cohort differences} = \frac{E + E' - F - F'}{2}.$$

The time of measurement variable confounds the amount of school experience with age differences; i.e. the testing in April reflects differences attributable to the increased age as well as increased school experience.

This part of the study was designed to evaluate the role of school experience with age controlled. Control of the variable was accomplished by using children whose birthdates were as close as possible to the cut-off date (December 1) for class placement with the results that the total age range for the two groups was about one month. The same children were measured in both October and April (see Table 4).

Several possible problems do exist with this design but they did not seem insurmountable. One possible factor is the practice effect associated with repeated testing. However, with a six month interval and the types of tests being utilized, this should not have been a

Table 4

Groups for Experiment II

	Time of measurement	
Cohort	October	April
Kindergarten	5-10	6-4
First grade	5-11	6-5

significant factor in the results of this study. Another possible problem was attrition. The most likely causes for this, such as moving and illness, are likely not related to the variables being studied. Demoting a child to a lower grade might be related to the skills being studied but rarely does this occur in the middle of first grade or kindergarten. More serious was the fact that raw scores had to be used in order to analyze all the tests as standard scores were not available for some of the tests. It is conceivable that the raw scores do not occur on a scale with even intervals. The average scores of the kindergarten and first grade groups were likely to be different so that different parts of the scale were predominantly used for the two groups. It is highly unlikely that this influenced the results on all tests but might have affected the results on some of the tests.

An analysis of variance was also used to analyze this set of results. However, the time of measurement effect was confounded with both an increase in school experience and age. Thus, only the cohort variable and the interaction were considered important.

Hypotheses

Experiment I

1. Kindergarten children who are the same age but differ by six months in the length of school experience will not show significant differences in scores on visual perception tests.
2. Kindergarten children who have had equal amounts of school experience but differ by six months in chronological age will not show significant differences in scores on visual perception tests.
3. The effect of school experience on performance on visual perception tests is the same for kindergarten children of different chronological ages.

Experiment II

1. Children who are in the first grade will not perform significantly better on visual perception tests than children of the same chronological age who are in kindergarten.
2. Changes in performance on visual perception tests will be the same for children of the same age regardless of whether they are in kindergarten or first grade.

Both experiments

1. For the subjects tested, chronological age or amount or type of school experience will have the same effect on performance on all visual perception tests regardless of what the test purports to measure or the type of response required.

Existing data for visual perception tests show differences in the average performance of children of different ages up to about age 8 or 10. However, increases in age are positively correlated with increases in school experience. It is conceivable that the improvement in performance is due entirely to school experience rather than any internal maturational factor related to chronological age. Or, of course, performance may be affected by both school experience and age. Another possibility is that children of different ages react differently to similar school experiences. For example, a younger child may lack the neurological organization needed to obtain maximal benefit from training in visual discrimination skills that occurs in the classroom.

In most school systems there is a difference in the time spent, stress upon, and even the type of visual perception tasks included in the curricula of kindergarten versus first grade. One could argue that activities in kindergarten, including "reading readiness" activities, should markedly improve performance in a child assumed to have had little formal training in visual perception skills before that time. In contrast the considerable amounts of time involved in letter discrimination while reading and writing may have a greater effect on performance on visual perception tests.

In Experiment I children of different ages had received the same school experiences while in Experiment II children of the same age received different school experiences. Thus, the interaction between age and school experience could take several forms.

A wide variety of tasks are included under the rubric of visual perception tests. One variable is the type of response. A number of the tests require the child to draw the stimulus. In this instance a number of factors related to the motor response such as skill in handling a pencil could affect the child's performance. This type of test could show a strong school effect from practice while a multiple choice test using similar stimuli and requiring comparable visual discrimination skills might not show a school effect. If there is indeed more than one type of processing skill involved in the perception of visual stimuli the effect of age and school experience may be different for different skills. Perhaps skill in figure-ground discrimination is related to non-school related factors such as neural maturation while skill in form discrimination is strongly affected by school experience.

Scores Analyzed

Raw scores were analyzed for all the tests and subtests in the study. For most of the tests except the Bender Gestalt this score represented the number of items correct. On subtest III (Form Constancy) of the Developmental Test of Visual Perception any incorrect items marked were subtracted from the total correct. On the ITPA Visual Sequential Memory subtest the child received two points if the stimulus was reproduced correctly on the first try and one point if correct on the second presentation. It was possible to earn half points on Visual III for reproductions that were recognizable but not completely accurate.

The score on the Bender Gestalt using the Koppitz scoring system is an error score with two to four possible errors on each figure scored for a total of 30 for the nine designs. Since the higher the score the poorer the child's performance a negative correlation with this test has the same meaning as a positive correlation between the other tests.

Where available standard scores were used for a second analysis. Since the same raw score would be assigned a different standard score depending on the chronological age of the child, any difference between groups of children that are different ages should be accentuated. In both experiments the six month difference in age between groups was sufficient to place the older and younger groups in different norm groups. The ITPA and Frostig have published standard scores for three month age groups. For the ITPA these scores have a mean of 36 and a standard deviation of 6. For the Frostig the scaled score is the perceptual age (the age for which that raw score is the average) divided by the chronological age, multiplied by 10 and adjusted to the nearest whole number.

The Southern California Visual Perception Test (SCFG) has standard scores for six month age groups with a mean of 0 and a standard deviation of 1. To avoid the negative scores these were transformed into a scale with a mean of 50 and a standard deviation of 10. The Bender Gestalt does not have published standard scores but Koppitz (1964) does give the mean and standard deviation for six month groups of the normative population. These were used to establish standard scores with a mean of 50 and a standard deviation of 10.

The published data on the Visual III test by Ilg and Ames (1964) does not include standard scores or standard deviations so this test could not be included in the analysis of standard scores. The Visual Memory test devised by the author has not been standardized.

METHOD

Subjects

Children from the Urbana Public Schools were selected on the basis of their birthdate. Eight of the nine elementary schools in the District agreed to participate in the study. The one school declining was in a predominantly black neighborhood with children bussed in from the university married students housing complex. However, black children are bussed to all the other schools on a percentage basis so their representation in the sample should have been reasonably similar to that of the community as a whole. No attempt was made to secure any background information such as race or socio-economic group.

Lists of children in regular classrooms who had birthdates in certain specified months were secured from each school. Subjects were selected by starting at a certain date and choosing successively younger or older children until the number needed had been selected. The groups were as shown in Table 5.

Table 5

Subjects

Testing date	Group	Grade	Birthdates	Males	Females	C.A. at Testing
October	A	K	6/9/66 to 6/30/66	10	5	5-4
October	B & E	K	12/16/65 to 12/20/65	8	7	5-10
October	F	1	11/11/65 to 11/29/65	7	8	5-11
April	C	K	11/3/66 to 11/21/66	9	6	5-4
April	D	K	6/2/66 to 6/11/66	4	11	5-10
April	E'	K	12/16/65 to 12/30/65	8	7	6-4
April	F'	1	11/11/65 to 11/29/65	7	8	6-5

During the October testing a total of four children had to be dropped from the study, two because the parents refused to give permission, one because of involvement in another research project, and one because the teacher asked that the child not be removed from the classroom.

Tests Used

There were two major criteria for the selection of tests:

1. The test involved the discrimination of line figures as forms rather than as meaningful symbols.
2. The test was suitable for use with five and six year old children.

Whenever possible two related tests which differed in the mode of response were utilized. For example both subtest II (Figure-Ground) of the Developmental Test of Visual Perception (Frostig, 1961) and the Southern California Figure-Ground Visual Perception Test (Ayres, 1966) test the ability to detect individual forms in line drawings with embedded and overlapping forms but the form of response is quite different for the two tests. The Frostig Figure-Ground subtest requires accurate tracing of the individual forms while on the SCFG the child points to the correct form from several alternatives.

There are also tests in which the mode of response is the same, but the visual perceptual skills needed differ. One example is the SCFG and the Visual Memory Test which are both multiple-choice tests. This arrangement provided some cross-check as to whether the results were influenced by the mode of response. For example, it could be possible that improvement in fine motor coordination due to age-related maturational changes could cause performance on tests requiring drawing or tracing to show a strong age component regardless of any visual perceptual skills needed.

This overlapping of tests also restricted the variety of skills that could be studied. It was thought to be more desirable to make a thorough appraisal of a few skills than sample a wide variety of skills.

There were two testing sessions about 45 minutes to an hour in length. During one session each child was tested on five relatively brief tests in the following order:

1. Visual Memory Test
2. Bender Visual Motor Gestalt Test
3. ITPA Visual Sequential Memory subtest
4. Southern California Figure-Ground Visual Perception Test
5. Monroe Visual III

The Visual Memory Test was devised by the author and consists of two demonstration and 30 test item cards containing a stimulus figure on one side of the 5 X 8 card and four choice figures on the other side. The stimulus figures are letter-like forms similar to those used by the Gibsons (e.g., Gibson, Gibson, Pick and Osser, 1962). In the final version there are 21 cards with single figures, seven with two figures and two with three figures. These were selected from a pool of 50 items on the basis of their correlation with the total score on the test by 40 four year old children tested at the nursery school at Children's Research Center. The four choice figures on the opposite side of the card differ from the stimulus in some of the ways alphabet letters differ from each other such as position in space, addition or subtraction of elements, and relationship of the parts to the whole. The child is shown the stimulus for five seconds and then the card is turned over to the choice figures and he is asked to "Find one like it here" (for complete directions see the Appendix). There are two trial items with separate cards so that the stimulus and choices can be shown to the child simultaneously in order to teach him the task. All 30 items are administered (takes 5 to 10 minutes) and the score is the total number of items correct. The test was designed to test the child's recognition memory for material similar to letters and short words. The use of the letter-like forms should help eliminate auditory images being used to remember the forms and equalize the children's experience with the stimuli which would not be the case with letters.

The Bender Visual Motor Gestalt Test (Bender, 1938) requires the child to copy nine designs on a blank sheet of paper. Using the scoring system by Koppitz (1964), the number of "errors" present were added up to obtain the raw score. The raw scores were transformed to normative scores by using Table 6 in Koppitz (1964) which gives the means and standard deviations of test scores of the normative sample in six month intervals. A transformation scale with a mean of 50 and a standard deviation of 10 was used to assign normative scores. The normative data were based on the records of more than 1,100 children between the ages of five and ten. A study by Miller, Loewenfeld, Lindner, and Turner (1963) found Pearson product-moment correlations of .88 to .96 between test scores by five raters. In a test-retest study of kindergarten and first grade classes and a four month interval the Kendall Rank Correlation coefficients were .55 to .66 (Koppitz, 1964).

The Visual Sequential subtest of the Illinois Test of Psycholinguistic Abilities involves the reconstruction of sequences of two to eight chips containing nonmeaningful figures. The child is shown the sequence for five seconds and then asked to put the corresponding chips in the tray in the same order as the stimulus. If he fails on the first attempt he is given a second trial. The test is discontinued when the child fails both trials of two consecutively listed items. The score is the total points on the basis of two points for each item passed on the first trial and one point for each item passed on the second trial. The scaled scores in the manual are at three month intervals with the mean performance of the standardization sample equal to a score of 36 with a standard deviation of 6. The internal consistency coefficients ranged from .60 to .96 for different ages of children. In a five month test-retest study the correlations ranged from .28 to .71 with the lower correlations occurring in the older groups of children (Paraskevopoulos and Kirk, 1969).

The Southern California Figure-Ground Visual Perception Test requires the child to indicate the three of the six choice figures which are in the stimulus plate of embedded or overlapping figures. The test is discontinued after a total of five errors. The raw score is the total correct choices. The published standard scores have a mean of zero and a standard deviation of 1 for six month age intervals. To avoid the negative scores these standard scores were transformed onto a scale with a mean of 50 and a standard deviation of 10. The norms for children from four to eleven are based on 1,164 children. A test-retest study with a one week interval yielded coefficients of correlation of .37 to .52 (Ayres, 1966).

The Gesell Institute has established norms for five to ten year old children for the Visual III subtest of the Monroe Reading Aptitude Tests (Ilg and Ames, 1964; Monroe, 1935). This test uses four sets of four nonmeaningful figures. After a set of figures has been displayed for ten seconds the child is told, "Now draw as many of the pictures as you can remember." Each form is scored as pass or fail with a half point score possible. Norms are based on 700 examinations but only 301 different children. Only means are given so it was not possible to compute standard scores. No studies of reliability could be found.

The Developmental Test of Visual Perception (Frostig, 1961) was administered during the other testing session. This test has five separate subtests. Test I (Eye-Motor Coordination) requires the child to draw straight or curved lines within increasingly narrow boundaries or to a target. Although this test is not concerned with visual form perception it was administered to keep the standard form of test administration. Test II (Figure-Ground Discrimination) requires the tracing of figures which intersect and overlap with other figures. Test III (Form Constancy) requires tracing only circles and squares which occur in varying sizes and positions and different surroundings on a page full of other figures. Test IV (Position in Space) involves the discrimination of the differences between figures in rotated and reversed positions. Test V (Spatial Relations) requires the reproduction of patterns of straight lines connecting pairs of dots. On subtests II, IV, and V the raw score is one point for each correct item. On subtest III one point is subtracted from the total correct for each incorrect figure the child outlines. The published standard scores are computed from perceptual ages which are the average age at which that score is achieved. To obtain the standard score the perceptual age is divided by the chronological age (mean for each three month span), multiplied by 10 and adjusted to the nearest whole number. The norms for the Frostig are for children from three to nine and are based on 2,116 unselected children. A two week test-retest study of kindergarten and first grade children yielded product moment correlations of .33 to .83 (Frostig et al., 1964).

Testing Procedures

The Frostig was usually administered to groups of two or three children while the other five tests were administered to individual children in the other testing session. The number of days between the two testing sessions ranged from two to fourteen days with a mean of seven days in both the October and April testing. During the October testing 33 children were administered the Frostig in their first session and 27 were administered the Frostig during their second session. During the April testing the figures were 34 and 26. Whenever possible the two sets of tests were administered by different examiners but nine children had the same examiner for both sessions in October and 19 during the April testing. There were a total of 11 examiners but the author did approximately half the testing.

RESULTS

Experiment I

Table 6 provides the means and standard deviations for the raw and the transformed scores. The transformed scores were obtained for each child and each test by using the scoring procedure and norms for each of the tests taken, whereas the raw scores reflect the number of items correct (or incorrect on each test). Since suitable normative data were not available for the Visual Memory and Visual III tests they had to be eliminated from the analysis of transformed scores. Tables 7 and 8 provide the results of the multivariate and univariate analyses of variance and the discriminant functions for these data. Tables 9 and 10 provide the intercorrelation matrices for the raw (Table 9) and the transformed (Table 10) scores. It should be noted that the Bender Gestalt provides an error score so a lower raw score indicates better performance.

As seen in Table 7, none of the multivariate analysis of variance F-ratios for the raw scores were statistically significant in this experiment. On the univariate analysis of variance the main effect for Time of Measurement for the Bender Gestalt was statistically significant ($p < .006$), reflecting superior performance under April testing. The analysis for the data from the ITPA Visual Sequential Memory subtest revealed statistical significance for the main effect of Age ($p < .04$), with older children performing better than younger ones. All other F-ratios failed to reach statistical significance.

In Table 9 the correlations with the Bender Gestalt are negative because this test has an error score. Although there is considerable

Table 6

Means and Standard Deviations for Age and Time of Measurement Groups in Experiment I

	Raw Scores								Transformed Scores							
	October				April				October				April			
	5-4		5-10		5-4		5-10		5-4		5-10		5-4		5-10	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
ITPA Visual Sequential																
Memory	15.0	3.7	16.7	2.4	16.0	3.4	17.7	3.0	36.0	5.4	36.6	3.7	37.6	5.0	38.3	4.5
Bender Gestalt	12.0	4.8	13.9	3.5	9.6	4.8	9.7	4.4	54.4	13.0	38.9	9.1	61.0	12.8	50.1	11.6
Visual Memory	16.7	2.7	17.3	3.7	17.4	4.0	18.7	4.4	----	----	----	----	----	----	----	----
Southern California																
Figure-Ground	13.2	2.9	13.2	4.0	13.8	3.8	14.6	3.4	54.6	8.6	52.9	13.6	54.3	10.9	57.8	11.3
Visual III	3.6	1.7	4.3	2.6	3.9	2.1	3.8	1.3	----	----	----	----	----	----	----	----
DTVP II Figure-Ground	13.7	4.1	12.6	4.7	14.3	4.0	14.1	4.5	11.1	2.2	9.5	1.9	11.5	2.5	10.3	1.9
DTVP III Form Constancy	6.7	3.5	6.2	3.2	6.7	3.6	9.5	4.0	10.9	2.6	9.3	2.4	10.8	2.8	11.8	2.9
DTVP IV Position in Space	5.4	1.7	5.5	1.5	5.9	1.8	5.6	1.6	11.3	2.1	9.4	1.4	12.4	2.5	11.0	2.3
DTVP V Spatial Relations	3.9	2.0	3.6	2.3	4.1	2.3	4.3	2.5	11.4	1.9	10.3	2.1	11.9	2.5	11.0	2.5

Table 7

Effect of Age and Time of Measurement on Raw Score Performance in Experiment I (Multivariate and Univariate ANOVA)

Test	F ratio and standardized discriminant function coefficients		
	Age	Time	Age X Time
All tests	$F_{9,48} = 1.09$ (NS)	$F_{9,48} = 1.66$ (NS)	$F_{9,48} = .79$ (NS)
ITPA Visual Sequential Memory	F = 4.30 ($p < .04$) -.798	F = 1.39 (NS) -.013	F = .01 (NS) -.166
Bender Gestalt	F = .77 (NS) -.886	F = 8.27 ($p < .006$) 1.300	F = .58 (NS) -.619
Visual Memory	F = 1.01 (NS) -.192	F = 1.15 (NS) .062	F = .14 (NS) .205
Southern California Figure-Ground	F = .19 (NS) -.418	F = 1.17 (NS) -.038	F = .19 (NS) .002
Visual III	F = .43 (NS) -.125	F = .02 (NS) .391	F = .62 (NS) -.722
DTVP II Figure-Ground	F = .35 (NS) .099	F = .90 (NS) .352	F = .13 (NS) -.064
DTVP III Form Constancy	F = 1.42 (NS) .357	F = 3.14 ($p < .08$) -.638	F = 3.14 ($p < .08$) .881
DTVP IV Position in Space	F = .006 (NS) -.013	F = .50 (NS) -.074	F = .30 (NS) -.504
DTVP V Spatial Relations	F = .003 (NS) .135	F = .55 (NS) .604	F = .16 (NS) -.157

Table 8

Effect of Age and Time of Measurement on Transformed Score Performance in Experiment I (Multivariate and Univariate ANOVA)

Test	F ratio and Standardized Discriminant Coefficients		
	Age	Time	Age X Time
All tests	$F_{8,49} = 5.42$ ($p < .0001$)	$F_{8,49} = 2.13$ ($p < .05$)	$F_{8,49} = .81$ (NS)
ITPA Visual Sequential Memory	F = .25 (NS) -.404	F = 1.69 (NS) .144	F = .001 (NS) -.143
Bender Gestalt	F = 17.74 ($p < .0001$) .959	F = 8.12 ($p < .0006$) -.791	F = .55 (NS) .374
Southern California Figure-Ground	F = .08 (NS) -.613	F = .60 (NS) .010	F = .75 (NS) .253
DTVP II Figure-Ground	F = 5.89 ($p < .02$) -.082	F = 1.08 (NS) .333	F = .11 (NS) -.688
DTVP III Form Constancy	F = .14 (NS) -.054	F = 2.81 ($p < .10$) -.011	F = 3.14 ($p < .08$) 1.11
DTVP IV Position in Space	F = 8.56 ($p < .005$) .110	F = 5.48 ($p < .02$) -.851	F = .22 (NS) -.289
DTVP V Spatial Relations	F = 2.94 ($p < .09$) .421	F = 1.10 (NS) -.662	F = .03 (NS) -.199

Table 9

Intercorrelation of Raw Scores Obtained by Different Age and Time of Measurement Groups in Experiment I

	Younger children - October testing								Older children - October testing							
Test	ITPA	BG	VM	SCFG	VIII	II	III	IV	ITPA	BG	VM	SCFG	VIII	II	III	IV
Bender Gestalt	-.44								-.38							
Visual Memory	.45	-.42							.23	-.62						
Southern California																
Figure-Ground	.38	-.37	.19						-.09	-.62	.27					
Visual III	.34	-.40	.46	.44					.37	-.59	.71					
DTVP II Figure-Ground	.19	-.59	.45	.23	.57				.17	-.77	.65	.63	.39			
DTVP III Form Constancy	.09	-.08	.00	.60	.34	.44			.11	-.07	.42	-.21	.19	.55		
DTVP IV Position in Space	.31	-.44	.46	-.21	.44	.67	.07		-.14	-.29	.19	.49	-.09	.59	.32	
DTVP V Spatial Relations	.33	-.69	.64	.20	.64	.88	.33	.64	.25	-.79	.42	.46	.32	.89	.49	.81
	Younger children - April testing								Older children - April testing							
Bender Gestalt	-.43								-.34							
Visual Memory	.61	-.36							.44	-.64						
Southern California																
Figure-Ground	.28	-.45	.34						-.27	-.54	.26					
Visual III	.36	-.58	.09	.54					.11	-.19	.54	.05				
DTVP Figure-Ground	.31	-.79	.19	.16	.46				.10	-.58	.31	.46	.32			
DTVP III Form Constancy	.47	-.42	.57	.23	.40	.64			.17	-.50	.35	.21	.54	.67		
DTVP IV Position in Space	.09	-.17	.35	.23	-.16	.56	.72		.45	-.51	.65	.32	.59	.66	.70	
DTVP V Spatial Relations	.50	-.75	.57	.74	.61	.75	-.04	.59	.30	-.54	.44	.25	.37	.75	.79	.66

Table 10

Intercorrelation of Transformed Scores Obtained by Different Age and Time of Measurement Groups in Experiment I

Test	Younger children - October testing						Older children - October testing					
	ITPA	BG	SCFG	II	III	IV	ITPA	BG	SCFG	II	III	IV
Bender Gestalt	.44						.44					
Southern California Figure-Ground	.37	.38					.05	.23				
DTVP II Figure-Ground	.22	.51	.15				.57	.84	.08			
DTVP III Form Constancy	.12	.10	.60	.35			.48	.40	.02	.38		
DTVP IV Position in Space	.32	.43	-.15	.37	.22		.12	.10	.06	.11	.04	
DTVP V Spatial Relations	.28	.66	.23	.80	.13	.46	.46	.75	.44	.63	.65	.10
	Younger children - April testing						Older children - April testing					
Bender Gestalt	.41						.33					
Southern California Figure-Ground	-.09	.62					-.32	.55				
DTVP II Figure-Ground	.05	.62	.56				.16	.47	.41			
DTVP III Form Constancy	.13	.05	.23	.54			.16	.49	.22	.67		
DTVP IV Position in Space	.31	.39	.12	.35	.46		.37	.49	.28	.71	.75	
DTVP V Spatial Relations	.20	.74	.45	.84	.38	.48	.32	.61	.25	.72	.78	.71

variation from group to group there are some consistencies. The various subtests of the Developmental Test of Visual Perception are fairly highly correlated except for Figure-Ground and Position in Space subtests in two groups. Correlations tended to be higher between tests which require the drawing the stimulus (such as the Bender Gestalt and Spatial Relations subtest of the DTVP) than between drawing tests and those with other modes of response. Generally, tests (e.g., the Southern California Figure-Ground test and the Figure-Ground subtest (II) of the Frostig) which purport to measure the same skill such as memory of figure-ground discrimination do not show higher correlations with each other than with other tests designed to test different skills (e.g., the other subtests of the Frostig).

In contrast to the results of the raw score MANOVA (Table 7), the analysis of the transformed scores (Table 8) revealed both main effects, Age and Time of Measurement, to be statistically significant.

On the ANOVA's of individual tests, the Bender Gestalt again showed a significant F-ratio for Time of Measurement similar to that seen with the raw scores. However, the transformed scores Age effect was also highly significant, revealing better performance by the younger children. The Figure-Ground (II) subtest of the Frostig also showed a significant age effect with the transformed scores. Using the transformed scores the Position in Space (IV) subtest of the DTVP showed a significant Time of Measurement effect. All other F-ratios including all of those for the interaction failed to reach statistical significance.

In determining the transformed scores, the younger and older children were compared to different groups of children as the norms for the tests were given in three or six month intervals. Thus the children five years four months old were generally compared to children five years to five years five months old while the older children were compared to children five years six months to five years eleven months old. The changes this made in the transformed score assigned to a given raw score were quite complex as can be seen to some extent by comparing the younger and older group means and standard deviations in Table 6.

Experiment II

The means and standard deviations of the raw and transformed scores are given in Table 11. Tables 12 and 13 provide the results of the multivariate and univariate analyses of variance and the discriminant functions for these data. Tables 14 and 15 provide the intercorrelation matrices for the raw and transformed scores.

In the multivariate analyses of variance of the raw scores the main effect for Time of Measurement was significant ($p < .001$). This experiment involved a repeated measurement design so there are several factors contributing to the difference in performance in April versus October. In the univariate analyses, there were a number of statistically significant effects; i.e., the main effects for Time of Measurement for the Bender Gestalt and Figure-Ground and Spatial Relations subtest of the Frostig ($p < .01$) and the Southern California Figure-Ground and Form Constancy and Position in Space subtests of the Frostig ($p < .05$) reflected better performance for the April testing. In addition, the main effect for Grade placement was significant ($p < .05$) for the ITPA Visual Sequential Memory subtest and the Bender Gestalt, revealing better

Table 11

Means and Standard Deviations for Grade Placement and Time of Testing Groups in Experiment II

Test	Raw Scores								Transformed Scores							
	October				April				October				April			
	K		1st		K		1st		K		1st		K		1st	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
ITPA Visual Sequential Memory	17.2	2.7	19.7	3.2	18.2	2.8	20.2	3.1	37.3	4.2	41.1	5.1	36.8	5.0	39.4	7.1
Bender Gestalt	13.8	3.3	9.5	3.3	7.6	5.3	6.5	3.3	38.9	8.7	51.3	9.0	52.1	12.5	54.8	7.6
Visual Memory	17.8	4.1	17.3	4.3	19.0	2.8	18.5	3.6	----	----	----	----	----	----	----	----
Southern California Figure-Ground	13.1	3.8	14.0	3.2	15.1	2.6	14.7	4.0	52.7	13.0	57.0	11.4	55.9	9.1	54.6	13.7
Visual III	4.6	2.7	5.6	2.0	4.8	2.4	5.7	2.0	----	----	----	----	----	----	----	----
DTVP II Figure-Ground	12.8	4.9	15.1	4.2	14.5	5.3	17.1	2.2	9.8	2.2	10.7	1.9	9.5	2.0	11.0	1.8
DTVP III Form Constancy	6.8	4.1	8.7	3.8	9.1	3.5	8.7	4.7	9.7	3.0	11.7	2.9	10.8	2.5	10.6	3.4
DTVP IV Position in Space	5.4	1.6	6.3	1.0	6.5	1.4	6.3	1.4	10.7	2.1	11.5	1.1	11.1	1.9	10.2	2.1
DTVP V Spatial Relations	3.6	2.3	5.0	1.4	4.2	2.3	5.5	1.2	10.2	2.0	11.4	1.5	11.0	2.0	11.3	1.3

Table 12

Effect of Grade Placement and Time of Measurement on Raw Score Performance in Experiment II (Multivariate and Univariate ANOVA)

Test	F ratio and standardized discriminant function coefficients		
	Grade	Time	Grade X Time
All tests	$F_{9,20} = 1.17$ (NS)	$F_{9,20} = 11.66$ ($p < .0001$)	$F_{9,20} = 1.69$
ITPA Visual Sequential Memory	F = 5.19 ($p < .03$) -.434	F = 3.38 ($p < .08$) -.361	F = .26 (NS) -.307
Bender Gestalt	F = 4.36 ($p < .05$) 1.185	F = 73.21 ($p < .0001$) .991	F = 8.61 ($p < .01$) .769
Visual Memory	F = .18 (NS) .799	F = 2.73 (NS) -.246	F = .002 (NS) -.112
Southern California Figure-Ground	F = .05 (NS) .675	F = 6.12 ($p < .02$) .047	F = 1.24 (NS) -.120
Visual III	F = 1.75 (NS) .081	F = .10 (NS) .038	F = .02 (NS) -.117
DTVP II Figure-Ground	F = 2.99 ($p < .09$) -.478	F = 8.73 ($p < .01$) -.445	F = .07 (NS) -.053
DTVP III Form Constancy	F = .29 (NS) -.077	F = 4.13 ($p < .05$) -.333	F = 4.14 ($p < .05$) -.604
DTVP IV Position in Space	F = .70 (NS) -.269	F = 5.88 ($p < .02$) .038	F = 4.58 ($p < .04$) -.338
DTVP V Spatial Relations	F = 2.50 (NS) .501	F = 10.75 ($p < .01$) -.245	F = 2.29 (NS) -.083

Table 13

Effect of Grade Placement and Time of Measurement on Transformed Score Performance in Experiment II
(Multivariate and Univariate ANOVA)

Test	F ratio and standardized discriminant function coefficients		
	Age	Time	Age X Time
All tests	$F_{8,21} = 1.02$ (NS)	$F_{8,21} = 5.93$ ($p < .0005$)	$F_{8,21} = 2.22$ ($p < .07$)
ITPA Visual Sequential Memory	F = 3.15 ($p < .09$) .310	F = 1.17 (NS) .064	F = .31 (NS) .284
Bender Gestalt	F = 5.04 ($p < .03$) .946	F = 34.00 ($p < .0001$) 1.179	F = 11.28 ($p < .002$) .874
Southern California Figure-Ground	F = .14 (NS) -.596	F = .04 (NS) -.283	F = 1.99 (NS) -.026
DTVP II Figure-Ground	F = 3.43 ($p < .07$) .654	F = 0 (NS) .324	F = .51 (NS) .075
DTVP III Form Constancy	F = .72 (NS) -.060	F = 0 (NS) .342	F = 5.90 ($p < .02$) .701
DTVP IV Position in Space	F = 0 (NS) -.044	F = 1.32 (NS) -.811	F = 4.54 ($p < .04$) -.253
DTVP V Spatial Relations	F = 1.64 (NS) -.811	F = 1.63 (NS) .312	F = 2.28 (NS) .191

Table 14

Intercorrelation of Raw Scores Obtained by Different Grade Placement and Time of Testing Groups in Experiment II

	Kindergarten children - October testing								First grade children - October testing							
Test	ITPA	BG	VM	SCFG	VIII	II	III	IV	ITPA	BG	VM	SCFG	VIII	II	III	IV
Bender Gestalt	-.45								.08							
Visual Memory	.42	-.56							-.09	-.57						
Southern California Figure-Ground	.04	-.58	.24						.13	-.50	.29					
Visual III	.42	-.63	.72	.22					.46	-.12	-.06	.48				
DTVP II Figure-Ground	.36	-.76	.68	.63	.49				.34	-.30	.21	.34	.15			
DTVP III Form Constancy	.39	-.12	.61	-.12	.31	.53			-.10	-.82	.39	.70	.20	.40		
DTVP IV Position in Space	.03	-.32	.38	.39	.64	.37	.24		.18	-.23	.01	.15	.36	.01	.07	
DTVP V Spatial Relations	.36	-.78	.42	.43	.39	.80	.40	.42	.10	-.43	.10	.20	.12	.85	.38	.03
	Kindergarten children - April testing								First grade children - April testing							
Bender Gestalt	-.35								.08							
Visual Memory	.23	-.36							-.09	-.50						
Southern California Figure-Ground	.57	-.52	.28						.13	-.50	.29					
Visual III	.37	-.69	.67	.46					.46	-.12	-.06	.48				
DTVP II Figure-Ground	.40	-.61	.53	.55	.61				.34	-.30	.21	.34	.15			
DTVP III Form Constancy	.33	-.11	.04	.05	.10	.38			-.10	-.82	.39	.70	.20	.40		
DTVP IV Position in Space	.47	-.30	.36	.09	.32	.38	.14		.18	-.23	.01	.15	.36	.01	.07	
DTVP V Spatial Relations	.71	-.65	.38	.42	.65	.58	.10	.65	.10	-.43	.10	.20	.12	.85	.38	.03

Table 15

Intercorrelation of Transformed Scores Obtained by Different Grade Placement and Time of Testing Groups in Experiment II

Test	Kindergarten children - October testing						First grade children - October testing					
	ITPA	BG	SCFG	II	III	IV	ITPA	BG	SCFG	II	III	IV
Bender Gestalt	.46						.18					
Southern California Figure-Ground	.03	.58					-.26	.48				
DTVP II Figure-Ground	.27	.53	.54				.11	.40	.46			
DTVP III Form Constancy	.39	.12	.13	.60			-.38	.51	.57	.27		
DTVP IV Position in Space	.04	.28	.35	.39	.29		.05	.41	.08	.13	.14	
DTVP V Spatial Relations	.27	.72	.39	.74	.36	.44	.24	.71	.27	.34	.45	.51
	Kindergarten children - April testing						First grade children - April testing					
Bender Gestalt	.37						-.16					
Southern California Figure-Ground	.58	.53					.14	.51				
DTVP II Figure-Ground	.41	.62	.45				-.02	.39	.40			
DTVP III Form Constancy	.35	.16	.11	.55			-.28	.84	.66	.53		
DTVP IV Position in Space	.50	.47	.27	.33	.16		.17	.14	.32	.04	.11	
DTVP V Spatial Relations	.70	.66	.41	.53	.09	.67	-.07	.39	.19	.80	.36	.12

performance for first grade children. The interaction effect was significant ($p < .05$) for the Bender Gestalt and Form Constancy and Position in Space subtests of the DTVP.

The means and standard deviations for the raw scores (Table 11) show several interesting patterns in the performances of the various groups. Almost without exception the performance of children was better in April than in October. However, the complexity of the interaction of the various factors operating is suggested by the number of tests on which the performance for the kindergarten children in April was equal to or slightly better than the first grade children in October.

The general pattern of intercorrelations for the raw scores in Experiment II resembled that of Experiment I. The subtests of the Frostig (except the Form Constancy and Position in Space subtests in some groups) are rather highly correlated. In addition, the tests with a drawing response (e.g., the Bender Gestalt and Spatial Relations subtest of the Frostig) tend to be more highly correlated with each other than with other tests.

The multivariate analysis of variance for the transformed scores again revealed statistical significance for the main effect of Time of Measurement ($p < .01$). In addition, the interaction of Grade Placement and Time of Measurement approached statistical significance ($p < .07$). In the univariate analyses of variance the Bender Gestalt again revealed significance for both main effects.

In contrast to the analyses of the raw scores, the Bender Gestalt was the only test to show a significant Time of Measurement or Grade Placement effect. The numerous significant interactions (including the

Bender Gestalt and the Frostig Form Constancy and Position in Space subtests) in general, revealed greater differences in performance between the kindergarten and first grade groups at the October testing. This is especially apparent for the Bender Gestalt test.

In this experiment the difference in normative groups to which the children were compared occurs as part of the difference in the two times of measurement. Thus the same children were compared to one norm group in October and to a different (older) group in April. This could be a factor in the generally higher F-ratios for the Time of Measurement for the transformed scores.

DISCUSSION

The Role of Age Factors

In Experiment I there were two different age groups (5 years 4 months and 5 years 10 months). Within each age group were two subgroups with different amounts of school experience (children of each age were tested in October and April). When raw scores for the two age groups were compared the difference in scores on only one test reached statistical significance.

These results appear to contradict the published normative data for the various tests. However, several factors need a closer examination. Using the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, and Kirk, 1968) norms as an example (since it has norms at three month intervals over a fairly wide age range), a question is raised whether the difference in performance between age groups is really as large as is suggested by the way the norms are published. Scale values are given for groups of children spanning only three months and also an age equivalent is given for every raw score. If two adjacent age groups are compared the difference in scaled scores for any given raw score is usually one or two points. However the standard deviation of the scaled scores is 6 so the difference is not really very large. It seems quite possible that the differences in performance between age groups in the normative sample three or even six months apart would not be statistically significant if subjected to an analysis of variance.

Since the transformed scores assigned to the raw scores vary with the child's age, it was expected that the transformation would change the relative performance of each group represented in Experiment I. The anticipated result was that the difference in mean scores for the two age groups would decrease since the same raw score for the older group would generally be assigned a lower transformed score than the same raw score earned by a younger child. In fact, the pattern of the transformed scores showed that the younger children manifested better relative performance than the older children, particularly at the October time of testing. This result suggests that the difference in the performance of the norm groups is related to the average amount of school experience children of a particular age have had. In other words, when children of a given age with less than average school experience are compared to the appropriate (i.e., equal CA) norm group, their performance would be underestimated because of being assigned a score based on the performance of a group with more school experience. The opposite result would occur with a group of children with more than the average amount of school experience. This would explain why a negative relationship between age and performance occurred for the analyses involving the transformed scores.

The child's age at the time of testing defines his cohort and thus his position in the range of ages present in the classroom. In this experiment there was essentially one group each from the youngest and oldest children plus two groups from the middle of the age span. There was no significant age by time of testing interaction effect seen on any of the tests which suggests that the effect of school experience for the two extreme groups is not different from that for the two middle groups. However this type of design does not permit a comparison of the school effect on the youngest and oldest children as they are not tested at the same point in time.

In Experiment II age was only one of the factors associated with the differences in the two times of measurement. In addition, the time of measurement included six months of additional but different (kindergarten versus first grade) school experience for the two groups plus potential influences of the effect of repeated testing. This confounding makes it difficult to judge the role of increased age in the differences in performance seen at the two times of testing. There were significant differences in performance on six of the nine tests with two of the other three tests approaching the .10 level of significance. The multivariate analysis of variance showed a significant (p < .0001) Time of Testing effect but the Bender Gestalt contributed heavily to this. These results indicate that an increase in age combined with the other factors is related to a significant improvement of test performance but the design does not permit an analysis of the effects of the several confounded factors.

The Role of School Experience

In Experiment I there was a six months difference in school experience between the two times of testing (October versus April). When the raw scores of children of the same age (at the time of testing, not the same cohort) were compared the performance on only one test, the Bender Gestalt, revealed significant differences. The Bender Gestalt requires a child to reproduce a design and it is fairly easy to see a relationship between this skill and being able to print letters accurately.

All but possibly one kindergarten included writing letters and words in its program.

The lack of significant differences for the raw score analyses on the other tests suggests that at least in this experiment school experience was not a powerful influence on performance. However, the means in Table 6 show there was a difference in performance on almost all tests but that it was fairly small in terms of the variability within the group as expressed by the standard deviations. In most instances, the difference between time of testing groups was at least as large as between different age groups. This combined with the fact that the age effect did not generally reach significant levels either suggests that school experience should not be excluded as a possibly very important factor but that further study is needed to determine its relative role.

In general, the pattern of results in Experiments I and II provide an interesting picture. The analyses of the raw scores from both experiments suggest the absence of statistically significant effects attributable either to school experience or chronological age. This was true even though small but generally consistent differences in performance were revealed across all tests, these differences favoring the children tested later in the school year.

The analyses of the transformed scores in Experiment I, however, indicated statistically significant effects attributable to both school experience and chronological age, the relationship being positive in the case of the former and negative for the latter variable. This pattern of results suggest:

1. that age differences in normative patterns on the tests are likely due to the fact that the norm groups on which the tests were standardized differed both in terms of chronological age and school experience, and
2. that amount of school experience is the likely factor responsible for the performance differences among age groups revealed in the norms on the various tests.

In other words, cross-age comparisons (with school experience controlled) involving normative scores places the older children within a class at a relative disadvantage since the norms were developed on groups where chronological age and school experience covaried.

Since grade placement groups a whole year's age span of children together, the relationship between age and school experience is somewhat complex. Essentially what happens is that the youngest children in each grade would have had more school experience than the average for their age and the oldest would have had less than average. If the transformed scores for the youngest (5-4 in April) and the oldest (5-10 in October) are compared to the mean for their age group, it can be seen that the mean for the youngest group is above the mean of the norm group and the mean for the oldest group is below the norm group on all but two tests.

Similarly, comparisons across levels of school experience should yield positive influences of schooling when the scores are transformed. It should be noted that such conclusions are possible only if school experience is the primary factor influencing performance on the tests used in the present study.

These interpretations are partially supported by the results of Experiment II where the results reflected in the analyses of the raw and transformed scores were very similar. In this instance both the kindergarten and first grade children were compared to the same norm group because of their similarity in ages. Thus one group was not differentially favored over the other. Where the transformation involved different norm groups (in the time of measurement effect) statistically significant differences were revealed.

In the analyses of the grade placement effect in Experiment II a number of the tests failed to show significant differences in the two groups. However, the two times of testing for each group were combined for these analyses. Most of the tests failing to show a significant main effect for grade placement effect did yield a significant interaction effect. This interaction effect was due to a greater improvement in performance by the kindergarten children in comparison to the first grade children. Thus averaging the scores for the kindergarten group at the two times of testing tends to obscure the difference which existed at the October time of testing.

Experiment II involved a comparison of two groups of children (kindergarten and first grade) who had different amounts of school experience prior to the first testing and who, between the two times of testing, had different types of school experience. It is possible that the tests used in the present study are those whose task demands are closely related to the types of readiness activities included in the kindergarten curriculum. If it were possible to plot a learning curve for a task such as judging differences in position in space there might well be a steep acceleration at the beginning of kindergarten (which is generally the first time this aspect of visual stimuli is stressed) with little improvement thereafter. With this reasoning, school experience may be viewed as influencing performance primarily for the kindergarten children. Again, however, these comments relate to the analyses of the transformed scores.

If there is, however, an interaction between the type of school experiences a child had and his chronological age then the picture is more complicated. In this experiment the kindergarten children were the oldest in their class while the first-grade children were the youngest. It is possible that the first-grade children lacked some factor such as neurological maturity needed to benefit maximally from first-grade experiences.

Visual Perception Tests

There are a number of elements of the results of this study which lead to questions about the current use and interpretation of visual perception tests. One concerns what the tests are actually measuring. Tables 9, 10, 14, and 15 give the intercorrelations seen in the various groups. Although there are some similarities, there is also considerable sample to sample variation. Most of these tests have fairly low test-retest reliability, so correlations should be interpreted with care. Tests which are described as testing essentially the same skill such as the two figure-ground tests, the Southern California Figure-Ground test and Figure-Ground subtest of the Frostig, and three visual memory tests, the ITPA Visual Sequential Memory subtest, Visual Memory, and

Visual III, in general did not correlate more highly with each other than with other tests. There was a tendency for performance on tests requiring accuracy in drawing the stimulus such as the Bender Gestalt and the Spatial Relations subtest of the Frostig to show a stronger relationship with one another. It would appear there are some identifiably different aspects of visual perceptual skills in addition to a basic underlying skill possibly related to the effectiveness with which the child uses the various structures of the visual apparatus. However, it is quite likely we have not even begun to identify the specific factors, let alone devise appropriate tests.

There is an additional problem in that the child must make some kind of response in order for us to measure his performance. On a task as complex as reproducing designs, as is used on the Bender Gestalt, clinical experience has suggested that there are a number of possible factors that can affect a child's performance. One is indeed related to visual skills such as the ability to scan effectively to form an accurate Gestalt or the ability to match on different stimulus characteristics such as angle, or relative size. However, children with subtle disorders of the motor system may be unable to reproduce the design although they know perfectly well what they are to draw and how what they have drawn differs from the sample. Other children may have good motor skills but have difficulty in visually guiding what they do. Until such time as a matrix of tests are developed which vary only on a single factor related to the task demands, it is unlikely that we will be able to investigate the relationship between the various visual perceptual skills now described in the literature.

Several aspects of the statistical results of this study suggest caution in the numerical aspects of test interpretation. For example, the performance did not differ for groups of children who differed in age by six months and had the same school experience. The test manuals present data in such a way that it is easy to be led into thinking that there is a fairly good-sized change in performance from one age group to another. For example, the manual for the Developmental Test of Visual Perception (Frostig _et al._, 1964) presents standardization curves, plotting raw scores versus chronological age, which climb upward fairly rapidly between the ages of three and eight. Norm tables are given with the scaled scores for all tests for one age together in a table, rather than for all ages on each test, making it difficult to compare the differences in performance from one age group to the next. Generally, the standard deviation of the scaled scores is large enough that the same scaled score is not assigned to more than one raw score, in fact there is often a several point difference. It is all too easy to lose sight of the size of the standard deviation and get the impression that the differences in performance between the age groups is larger than it really is.

Not only do we need to consider the size of the differences in group means but also the variability within the group. The range of scores within each of the experimental groups in this study was considerable, particularly in light of the limited number of items on some of the tests. Except for the Visual Memory test, and the ITPA Visual Sequential Memory subtest there were eight or less items in each test. Even when the test had a large number of items the actual number of items that discriminated well at that age range was small. With the limited points available on each subtest, scores even two standard deviations above or below the mean were not possible on many of the tests.

The variability within versus between groups particularly needs to be considered when age equivalents are given for raw scores. A child whose score falls within one standard deviation of the mean for his norm group may "earn" an age equivalent a year or more different from his chronological age. It is all too easy to label a child as deficient or retarded in terms of a skill when his "true score" is really quite typical for his age. Furthermore, the test-retest reliability for these tests is only moderate at best.

There has been a fair amount of discussion about some of the difficulties caused by having several short subtests purporting to measure different skills. One side of the argument says that to sum these scores together is like putting apples and oranges together and describing how much fruit you have. This gives a figure which is not very helpful if you want to make an apple pie. This is the view expressed by those who stress the importance of discrete visual perceptual skills (e.g., Frostig, Ayres). A major criticism of such tests has been that the test reliability is too poor for the small sample of behavior taken in each subtest. Even if there are discrete visual perceptual skills you fail to measure them with sufficient accuracy to be useful. Hopefully, as the interrelationships of the various types of skills needed for various visual tasks are better understood a different type of test structure will be possible. This would include a gross screening test with complex tasks requiring several skills so that all the skills would be needed to pass the test but an inordinate number of items would not be needed. Correlated with this would be a matrix of tests involving known and limited combinations of skills which could be used to determine specifically why a particular child fails at certain tasks.

The present results also permit some tentative suggestions regarding the basis for establishing norms on the tests. The present normative scoring procedure used on the tests utilizes chronological age as the base. The results of the present study suggest the absence of a relationship between performance and chronological age when school experience is controlled. As already suggested, it is likely that current procedures for selecting normative samples result in the confounding of chronological age-related factors and the amount of school experience. Furthermore, the analyses relating to the transformed scores in Experiment I suggested that school experience was the primary factor contributing to the performance differences in the normative samples. If this reasoning is correct, the performance of older children within a grade would be underestimated in relation to normative profiles. If this is the case, a strong argument can be made for using norms based on grade placement.

SUMMARY

Restatement of Purpose

This study attempted to investigate the effects of school experience on visual perception tests involving line figures and forms. These tests, which are generally used to "diagnose" the causes of school difficulties, have norms which are based on chronological age and do not take into account the amount of school experience.

If the various activities in the kindergarten and first grade curricula designed to develop visual skills do indeed foster such development one would expect to see differences in performance related to the amount of school experience. The average performance for children of a given age such as 5 years 4 months should be higher if they are tested in the spring near the end of kindergarten rather than in the fall when school experience is just beginning. This would result in children with different birthdates showing different average levels of a skill due to the relationship of chronological age and school experience.

There were two experiments in this study. Experiment I attempted to examine the independent and interactive influences of school experience and chronological age in kindergarten children. Experiment II attempted to compare the effects of kindergarten and first grade curricula on performance on visual perception tests.

Procedure

Children were selected on the basis of birthdate from eight of the nine elementary schools in Urbana, Illinois. There were 15 children in each of the groups.

In Experiment I a time-sequential design as outlined by Schaie (1965) was used. This design permits inferences as to age differences as well as differences related to the time of measurement. The ages were 5 years 4 months and 5 years 10 months and the testing times were in October and April.

	Time of testing	
Age	October	April
Younger	5-4	5-4
Older	5-10	5-10

In Experiment II, a test-retest design was used with kindergarten and first grade children whose birthdays were close to the December 1 cut-off date so the two groups were less than one month apart in age. Testing dates were October and April.

Tests chosen had to meet two major criteria:

1. The test involved the discrimination of line figures as forms rather than as symbols with meaning.
2. The test was suitable for use with five and six-year-old children.

An attempt was made to include more than one test of what appeared to be a similar processing task but which had different types of response such as multiple-choice versus copying.

The tests chosen were:

1. The Developmental Test of Visual Perception (Frostig, 1961)
2. Visual Memory Test (Wood, 1971)
3. Visual Motor Gestalt Test (Bender, 1938; Koppitz, 1964)

4. The Visual Sequential Memory subtest of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, and Kirk, 1968)

5. The Southern California Figure-Ground Visual Perception Test (Ayres, 1966)

6. Visual III from the Reading Aptitude Tests (Monroe, 1935)

There were two testing sessions of 45 minutes to an hour, at least two days apart. In one session the Developmental Test of Visual Perception was administered, usually to a group of two or three children. In the other session tests 2 to 6 were administered to individual children in the order listed.

Results

In Experiment I the multivariate analysis of variance of the raw score performance on the tests showed that all F-ratios for the tests as a group failed to reach statistical significance. On the individual analyses of variance the ITPA Visual Sequential Memory subtest had an Age F-ratio significant at the .05 level, and the Bender-Gestalt had a Time of Measurement F-ratio significant at the .01 level. All other individual F-ratios failed to reach statistical significance in the raw score analyses. However, the analyses of the transformed scores indicated that the amount of school experience was positively related to performance and that chronological age was negatively related to performance.

In Experiment II the multivariate analysis of variance showed that the F-ratio for the Time of Measurement was significant at the .01 level. This factor confounded an increase in age, school experience, and familiarity with the tests. On the individual analyses of variance five tests had significant F-ratios on the Time of Measurement factor -- the Bender-Gestalt, Southern California Figure-Ground Visual Perception test and three of the subtests of the Developmental Test of Visual Perception. Two tests had significant F-ratios on the Grade Placement factor -- the ITPA Visual Sequential Memory subtest and the Bender-Gestalt. There were also three significant F-ratios for the Grade by Time of Measurement interaction. These occurred with the Bender-Gestalt and Form Constancy and Position in Space subtests of the Developmental Test of Visual Perception. These interactions suggested that kindergarten children manifested greater improvement from October to April than did first-grade children. The results of the analyses of the transformed scores were similar to those of the raw scores.

Implications

The lack of clear-cut results in this study suggest a need for further investigation of the role of training in performance on visual perception tests. Although the test results generally did not show a statistically significant school experience effect, neither was there a significant difference in the groups six months apart in age. The differences in groups of children six months different in age with the same school experience were actually quite small. Only when a difference in school experience and familiarity with the tests was combined with a six months difference in age did significant differences appear on most of the tests.

A closer look at the size of the standard deviations and the differences in mean performance of different age groups is needed. It is extremely rare to find a test where the difference in the mean scores for groups even a full year apart in age is as large as one standard deviation. If the age equivalent scores are used it is quite possible for a child whose score is within one standard deviation of the mean for his age group to be assigned an age equivalent one year or more below his chronological age with the implication that he has a serious lag in the development of that skill.

In Experiment II the interaction effects indicate a greater change in six months for the kindergarten children in comparison to the first grade children. It appears that probably there is a comparatively more rapid change in certain skills at the beginning of a child's formal school experience with a relative leveling off of the curve later. This pattern could be different in communities where attendance at structured nursery school is common or where public kindergartens do not exist. Particular caution should be used when interpreting the scores of children just beginning school or who are of kindergarten age but not yet in school.

Most critical is the finding that the present normative groups based on age penalize the child who is among the older children in his grade. In contrast the younger children in a grade tend to have performances above average for their age group, presumably because they have had more school experience than the average for their age. Although renorming the present tests on the basis of grade placement is probably impractical, the manuals should mention the role of school experience. Particularly for the five and six year old children who would be starting school the size of the variation related to grade placement should be investigated and reported so it could be used in interpretation of the scores.

Although the relatively low test-retest correlation of the test scores limits the accuracy of correlations between scores on different tests, the number of high correlations between tests supposedly measuring different skills (as well as some very low correlations between tests described as measuring the same skill) suggest the need for further study of what the present tests are really measuring and how accurately they discriminate between differences in abilities essential to academic success.

LIST OF REFERENCES

Ashlock, P. The visual perception of children in the primary grades and its relation to reading performance. In J. A. Figurel (Ed.), Reading and inquiry. Proceedings of the International Reading Association, 1965, 10, 331-332.

Ayres, A. J. Southern California Figure-Ground Visual Perception Test. Los Angeles: Western Psychological Services, 1966.

Baker, H. J., & Leland, B. Detroit Tests of Learning Aptitude, Examiners Handbook. Indianapolis: Bobbs-Merrill, 1967.

Baltes, P. B., Baltes, M. M., & Reinert, G. The relationship between time of measurement and age in cognitive development of children: An application of cross-sectional sequences. Human Development, 1970, 13, 258-268.

Barrett, T. C. The relationship between measures of pre-reading visual discrimination and first grade reading achievement: A review of the literature. Reading Research Quarterly, 1965, 1, 51-76. (a)

Barrett, T. C. Visual discrimination tasks as predictors of first grade reading achievement. Reading Teacher, 1965, 18, 276-282. (b)

Barrett, T. C. Goals of the reading program: The basis for evaluation. In A. Beery, T. C. Barrett, & W. R. Powell (Eds.), Elementary reading instruction. Boston: Allyn and Bacon, Inc., 196.

Beery, K. E. Visual-motor integration. Chicago: Follett Publishing Company, 1967.

Bender, L. A visual motor Gestalt test and its clinical use. American Orthopsychiatric Association Research Monograph #3, 1938.

Benton, A. L. A visual retention test for clinical use. New York: The Psychological Corporation, 1946.

Betts, E. A. Factors in readiness for reading. Educational Administration and Supervision, 1948, 19, 199-230.

Bond, G. L., & Wagner, E. B. Teaching the child to read. New York: The MacMillan Company, 1950.

Bryan, Q. R. Relative importance of intelligence and visual perception in reading achievement. California Journal of Educational Research, 1964, 15, 44-48.

Carter, L. B. The effect of early school entrance on the scholastic achievement of elementary school children in the Austin Public Schools. Journal of Educational Research, 1956, 50, 91-103.

Corah, N. L., & Powell, B. J. A factor analytic study of the Frostig Developmental Test of Visual Perception. Perceptual and Motor Skills, 1963, 16, 59-63.

Craddick, R. A. WISC and WAIS as a function of season birth. Psychological Reports, 1966, 18, 259-264.

DeBoer, J. J., & Dallman, M. The teaching of reading. New York: Holt, Rinehart & Winston, Inc., 1964.

Dennis, R., & Dennis, M. Dennis Visual Perception Scale. Los Angeles: Western Psychological Services, 1971.

Dickinson, D. J., & Larson, D. J. The effects of chronological age in months on school achievement. Journal of Educational Research, 1963, 56, 492-493.

Dunn, S. S. Review of the Harrison Stroud Reading Readiness Profiles. In O. K. Buros (Ed.), The fifth mental measurements yearbook. Highland Park, N. J.: The Gryphon Press, 1959.

Fellows, B. S. The discrimination process and development. New York: Pergamon Press, 1968.

Fialkin, H. N., & Beckman, R. O. The influence of month of birth on the intelligence scores of adults. Journal of Genetic Psychology, 1938, 52, 203-209.

Frostig, M. Developmental Test of Visual Perception. Palo Alto, Calif.: Consulting Psychologists Press, 1961.

Frostig, M. et al. The Marianne Frostig Developmental Test of Visual Perception, 1963 standardization. Perceptual and Motor Skills, 1964, 19, 463-499.

Frostig, M., & Horne, D. The Frostig Program for the Development of Visual Perception. Chicago: Follett Publishing Company, 1964.

Gates, A. I. The necessary mental age for beginning reading. Elementary School Journal, 1937, 37, 497-508.

Gates, A. I. Further evaluation of reading readiness tests. Elementary School Journal, 1940, 40, 577-591.

Gibson, E. J., Gibson, J. J., Pick, A. D., & Osser, H. A developmental study of the discrimination of letter-like forms. Journal of Comparative and Physiological Psychology, 1962, 56, 897-906.

Goins, J. T. Visual perceptual abilities and early reading progress. University of Chicago Supplementary Educational Monograph, 1958, No. 87.

Goodenough, F. L. Intelligence and month of birth. Psychological Bulletin, 1940, 37, 442.

Graham, F. K., & Kendall, B. S. Memory-For-Designs Test; Revised General Manual. Perceptual and Motor Skills, 1960, Monograph 2-VII.

Gray, W. S. Summary of investigations relating to reading. University of Chicago Supplementary Educational Monograph, 1925, No. 28.

Hake, H. W. Form discrimination and the invariance of form. In L. Uhr (Ed.), Pattern recognition. New York: John Wiley and Sons, Inc., 1966.

Hall, R. V. Does entrance age affect achievement? Elementary School Journal, 1963, 63, 391-396.

Hildreth, G. H., Griffiths, N. L., & McGauvran, M. E. Metropolitan Readiness Tests. New York: Harcourt, Brace, and World, Inc., 1966.

Hirst, W. E. Entrance age: A predictor variable for academic success? Reading Teacher, 1970, 23, 547-555.

Huntington, E. Season of birth. New York: Wiley and Sons, 1938.

Ilg, F. L., & Ames, L. B. School readiness: Behavior tests used at the Gesell Institute. New York: Harper and Row, 1964.

Jinks, R. An investigation into the effect of date of birth on subsequent school performance. Educational Research, 1964, 6, 220-225.

Kass, C. E. Some psychological correlations of severe reading disability (Dyslexia). (Doctoral dissertation, University of Illinois). Ann Arbor, Mich.: University Microfilms, 1962, No. 62-6271.

Keogh, B. K. Form copying tests for prediction of first grade reading. In 27th Yearbook Claremont Reading Conference, 1963.

King, I. B. Effect of age of entrance into Grade I upon achievement in elementary school. In V. M. Noll and R. P. Noll (Eds.), Readings in educational psychology. New York: The MacMillan Company, 1962.

Kirk, S. A., McCarthy, J. J., & Kirk, W. D. Illinois Test of Psycholinguistic Abilities. Champaign, Ill.: University of Illinois Press, 1968.

Koppitz, E. M. The Bender Gestalt Test for Young Children. New York: Grune & Stratton, Inc., 1964.

Lee, J. M., & Clark, W. W. Lee-Clark Reading Readiness Test, 1962 Revision. Monterey, Calif.: California Test Bureau, 1962.

Lodge, T. Variation in Stanford-Binet IQ's of preschool children according to the months in which examinations were given. Journal of Psychology, 1938, 6, 385-395.

Lord, E., & Wood, L. Diagnostic values in a visual-motor test. American Journal of Orthopsychiatry, 1942, 12, 414-428.

Miller, L. C., Loewenfeld, R., Lindner, R., & Turner, J. Reliability of Koppitz scoring system for the Bender Gestalt. Journal of Clinical Psychology, 1953, 19, 2111.

Miller, W. D., & Norris, R. C. Entrance age and school success. Journal of School Psychology, 1967, 6, 47-60.

Mills, C. A. Mental and physical development as influenced by season of conception. Human Biology, 1941, 13, 378-389.

Monroe, M. Reading aptitude tests. Boston: Houghton Mifflin Company, 1935.

Murray, B. B. A suggested method for pre-school identification of reading disability. Knoxville: Tennessee University Psychological Clinic, 1966.

O'Connor, W. J. The relationship between the Bender Gestalt Test and the Marianne Frostig Developmental Test of Visual Perception. In G. D. Spache (Ed.), Reading disability and perception. Proceedings of the International Reading Association, 1969, 13, 72-81.

Ohnmacht, F. W., & Olson, A. V. Canonical analysis of reading readiness measures and the Frostig Developmental Test of Visual Perception. Educational and Psychological Measurement, 1968, 28, 479-484.

Olson, A. V. Factor analytic studies of the Frostig Developmental Test of Visual Perception. Journal of Special Education, 1968, 2, 429-433.

Orme, J. E. Intelligence, season of birth and climatic temperature. British Journal of Psychology, 1963, 54, 273-276.

Paraskevopoulos, J. N., & Kirk, S. A. The development and psychometric characteristics of the Revised Test of Psycholinguistic Abilities. Urbana, 111.: University of Illinois Press, 1969.

Petty, M. C. An experimental study of certain factors influencing reading readiness. Journal of Educational Psychology, 1939, 30, 215-230.

Phelan, Sister Mary B. Visual perception in relation to variance in reading and spelling: A statistical analysis. Catholic University of America Educational Research Bulletin, 1940, 12(3).

Pintner, R., & Forlano, G. The influence of month of birth on intelligence quotients. Journal of Educational Psychology, 1933, 24, 561-584.

Potter, M. C. Perception of symbol orientation and early reading success. Teachers College Contributions to Education, 1949(939).

Roberts, J. A. F. Intelligence and season of conception. British Medical Journal, March 4, 1944, 320.

Rosen, C. L. An experimental study of visual perceptual training and reading achievement in first grade. Perceptual and Motor Skills, 1966, 22, 979-986.

Rosenthal, M. A comparison of reading readiness achievement of kindergarten children of disparate entrance ages. Queens College, City University of New York, 1969.

Schaie, K. W. A general model for the study of developmental problems. Psychological Bulletin, 1965, 64, 92-107.

Silver, A. A., & Hagin, R. A. Maturation of perceptual functions in children with specific reading disability. Reading Teacher, 1966, 19, 253-259.

Silver, A. A., & Hagin, R. A. Visual perception in children with reading disabilities. In F. A. Young and D. B. Lindsley (Eds.), Early experience and visual information processing in perceptual and reading disorders. Washington, D. C.: National Academy of Sciences, 1970.

Sister Mary of the Visitation. Visual perception in reading and spelling: A statistical analysis. Catholic University of America Educational Research Bulletin, 1929, 4(1).

Spache, G. D., & Spache, E. B. Reading in the elementary school. Boston: Allyn and Bacon, Inc., 1964.

Stern, C., & Lombard, A. An instrument to measure visual discrimination in young children. Perceptual and Motor Skills, 1968, 26, 1207-1210.

Terman, L. M., & Merrill, M. A. Stanford-Binet Intelligence Scale, Manual for the Third Revision Form L-M. Boston: Houghton Mifflin Company, 1960.

Tinker, M. Visual apprehension and perception in reading. Psychological Bulletin, 1929, 26, 223-240.

Vernon, M. D. The perceptual process in reading. Reading Teacher, 1959, 13, 2-8.

Vernon, M. D. Perception through experience. New York: Barnes & Noble, 1970.

Ward, J. The factor structure of the Frostig Developmental Test of Visual Perception. British Journal of Educational Psychology, 1970, 40, 65-67.

Wechsler, D. Wechsler Intelligence Scale for Children. New York: The Psychological Corporation, 1949.

Wechsler, D., & Hagin, R. L. The problem of axial rotation in reading disability. Perceptual and Motor Skills, 1964, 19, 319-326.

Weiner, P. S. A revision of the Chicago Test of Visual Discrimination. Elementary School Journal, 1968, 68, 373-380.

Wheelock, W. H. An investigation of visual discrimination training for beginning readers. In H. K. Smith (Ed.), Perception and reading. Proceedings of the International Reading Association, 1968, 12(4).

Williams, J. P. Effects of discrimination and reproduction training on ability to discriminate letter-like forms. Paper presented at the annual meeting of the American Educational Research Association, 1968.

Williams, P. Date of birth, backwardness and educational organization. British Journal of Educational Psychology, 1964, 34, 247-255.

Winter Haven Lions Research Foundation. Perceptual Forms Test. Winter Haven, Florida, 1960.

Wood, P. A. Visual Memory Test. Unpublished, 1971.

APPENDIX

Instructions for the Visual Memory Test

Demonstration

Present stimulus card A with response card A face down underneath it. Display A for 5 seconds, saying TAKE A GOOD LOOK AT THIS DESIGN SO YOU CAN REMEMBER EXACTLY WHAT IT LOOKS LIKE. At the end of the 5 seconds turn the two cards over together so only the response card is exposed, FIND ONE LIKE IT HERE. After the child has indicated a choice, pull out the stimulus card, and re-expose so the child can check his response. If a correct choice, YES, THAT ONE IS THE SAME pointing to stimulus and choice. If not correct, NOT QUITE. POINT TO THE ONE THAT IS EXACTLY THE SAME. If able to find the correct choice, YES, THAT ONE IS THE SAME. If he still does not indicate the correct choice, put the stimulus card next to the correct choice and ask him if the designs are alike (if he does not say they are the same, have him show you how they are different). Then place stimulus card next to previous choice and ask him if they are exactly the same (if he says yes, assist him in seeing the difference). It is important that the child realize that only one design will be exactly the same as the stimulus.

Demo B is given in the same way except the fact that there are two parts to the design is stressed both by pointing to both parts and saying: SOME OF THE DESIGNS WILL HAVE MORE THAN ONE PART. BE SURE TO LOOK AT ALL OF THE DESIGN SO YOU CAN REMEMBER IT. Correction procedure is the same as with Demonstration A.

Administration

GOOD, NOW LET'S TRY SOME MORE DESIGNS. Display the stimulus card for 5 seconds saying, TAKE A GOOD LOOK. Turn the card over, FIND ONE LIKE IT HERE. The verbal cues can be dropped later if the child is performing smoothly. Re-exposure of the stimulus is not permitted. If the child gets restless and does not use the whole 5 seconds even when prompted, the exposure time can be shortened. Use remarks such as GOOD, YOU LOOKED AT ALL THE DESIGNS to encourage looking at all the response items and to discourage a position preference. Other remarks of encouragement such as YOU ARE DOING A NICE JOB can be used if needed. Tracing of the design should be gently discouraged as it does not permit looking at all of the more complex designs with the 5 seconds.

Instructions for Visual III of the Monroe Reading Aptitude Tests

"WE ARE GOING TO DRAW SOME PICTURES ON THIS FIRST LINE. PUT YOUR FINGER ON THE PLACE WHERE YOU ARE TO DRAW THE PICTURES. NOW, I WILL SHOW YOU THE PICTURES THAT YOU WILL DRAW. KEEP LOOKING AT THEM, BUT DO NOT DRAW THEM UNTIL I TAKE THEM AWAY." Examiner exposes the first card of set III for exactly 10 seconds. Remove and say "NOW, DRAW AS MANY OF THE PICTURES AS YOU CAN REMEMBER." Proceed in the same manner for the 2nd, 3rd, and 4th cards of set III, each time having the child indicate the appropriate line upon which to draw the pictures and warning them to wait until the card is removed before drawing.

If the child starts to draw while the pictures are still exposed, hold his pencil for him. If he looks elsewhere before the 10 seconds are up, it may be necessary to remind him to take a good look at all the pictures. If he appears distressed because he can remember only a few of the pictures, encourage him by telling him that he is doing nicely and that it doesn't matter if he can't remember every design; just draw the ones he can remember.

Instructions for Administration of the Bender Gestalt Test
(from Koppitz, E. M. The Bender Gestalt Test for Young Children)

Seat the child comfortably at an uncluttered table on which two sheets of paper, size 8-1/2" X 11", and a #2 pencil with an eraser have been placed. After rapport has been established show the stack of Bender cards to the child and say: "I HAVE NINE CARDS HERE WITH DESIGNS ON THEM FOR YOU TO COPY. HERE IS THE FIRST ONE. NOW GO AHEAD AND MAKE ONE-JUST LIKE IT." After the child has adjusted the position of the paper to suit himself, place the first Bender card, Figure A, at the top of the blank paper in front of the child. No comments are made while observations and notes are made on the child's test behavior. There is no time limit on this test. When a child has finished drawing a figure, the card with the stimulus design is removed and the next card is put in front of him and so on. All nine cards are presented in this fashion in orderly sequence.

If the child asks questions concerning the number of dots or the size of the drawings, etc. he should be given a noncommittal answer like; "Make it look as much like the picture on the card as you can." He should be neither encouraged nor discouraged from erasing or making several attempts at drawing a design. It has been found practical to discourage the counting of dots on Figure 5 since this requires much time and adds little new information. The children who count dots on Figure 5 also tend to count dots and circles of Figures 1, 2, and 3. When a child begins to count dots on Figure 5 the examiner may say: "You do not have to count those dots, just make it look like the picture." If the child still persists in counting the dots, it then takes on diagnostic significance. The indications are that the child is most likely quite perfectionistic or compulsive. If the child has filled most of the sheet of paper and turns it sideways to fit in Figure 8 into the remaining space, this should be noted on the protocol as this is not considered a rotation of design.

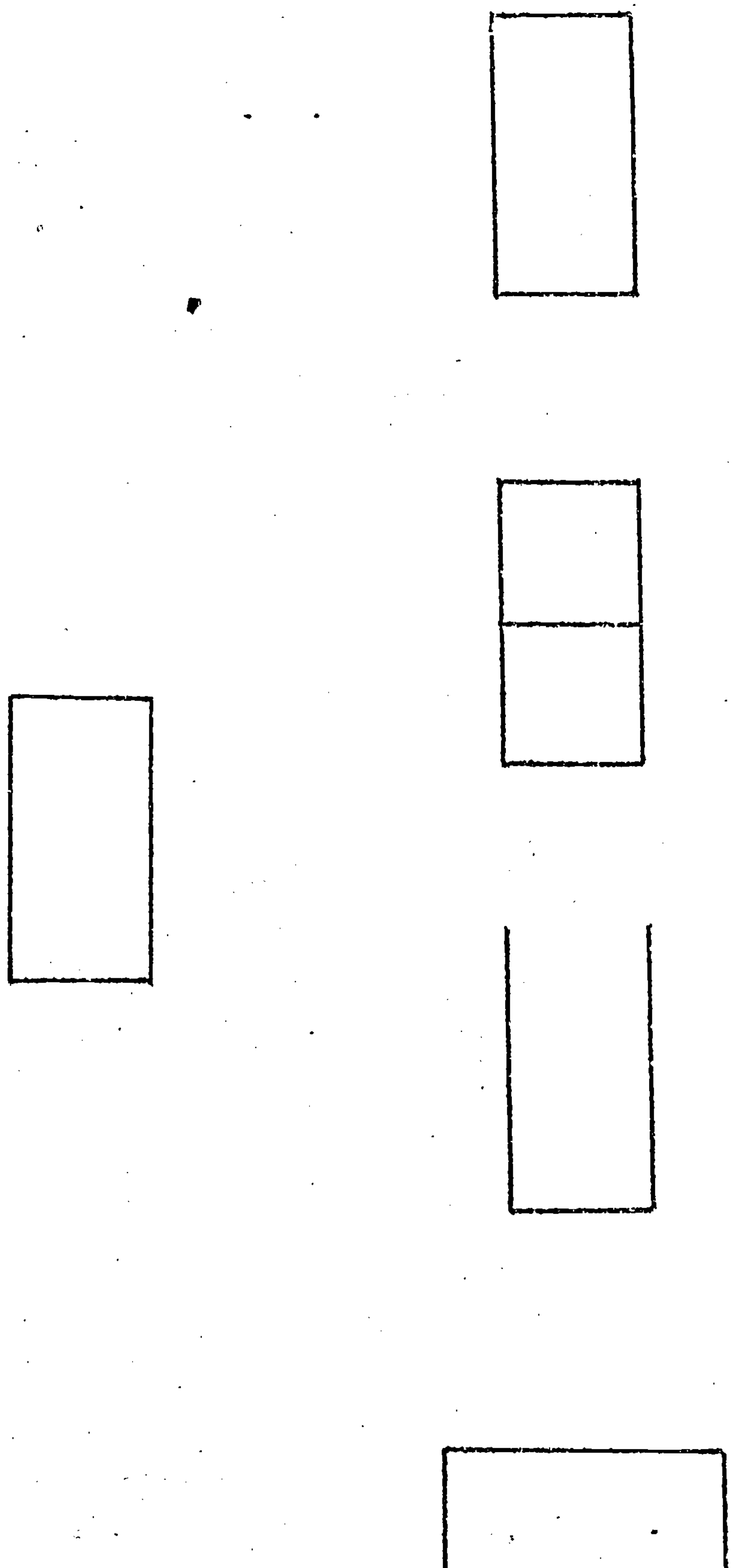
Each child is permitted to use as much paper (or as little) as he desires. If he asks for more than the two sheets of paper provided, he should be given additional paper without comment.

For directions for the Southern California Figure-Ground Visual Perception Test see Ayres, 1966.

For directions for the Visual Sequential Memory subtest see the manual for the Illinois Test of Psycholinguistic Abilities by Kirk, McCarthy, and Kirk, 1968.

For directions for the Developmental Test of Visual Perception see Frostig, 1961.

A



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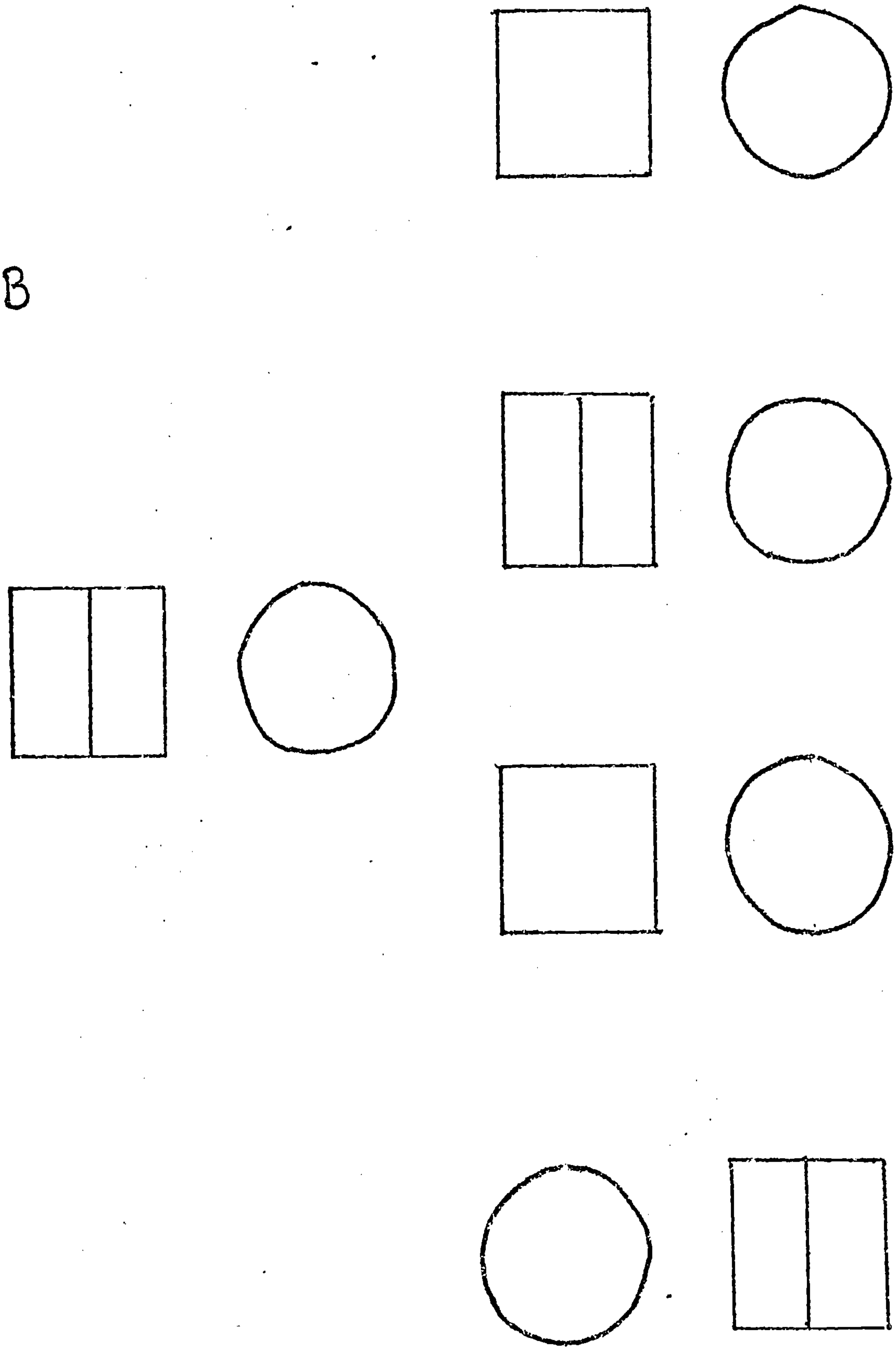

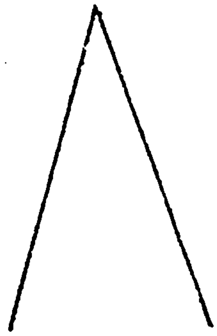

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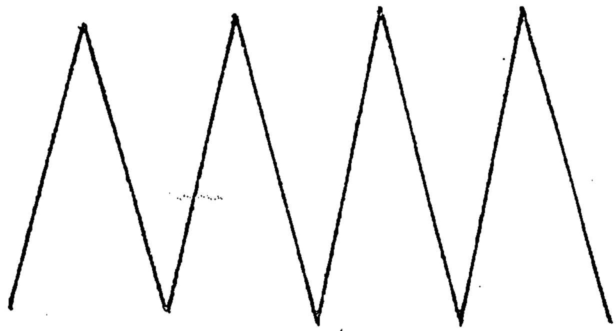

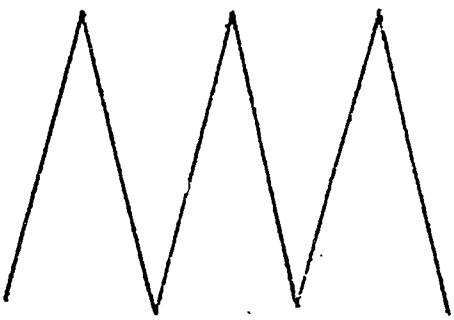

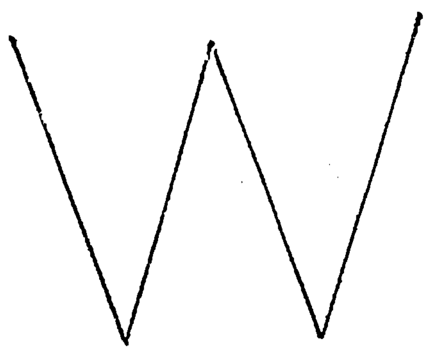

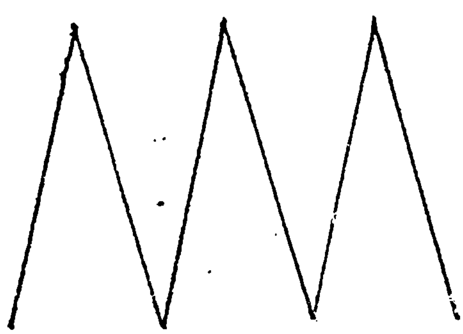

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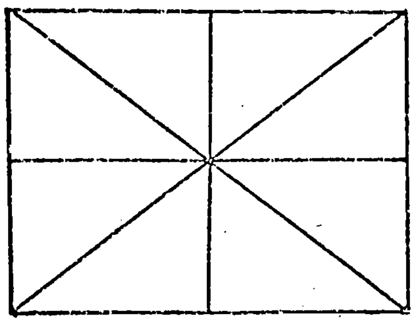

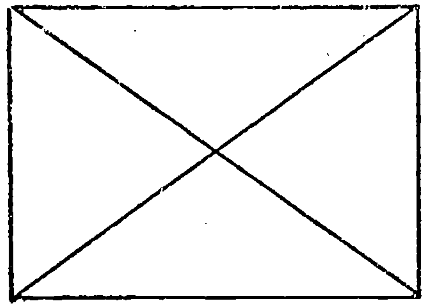

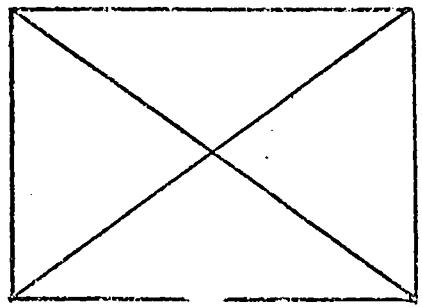

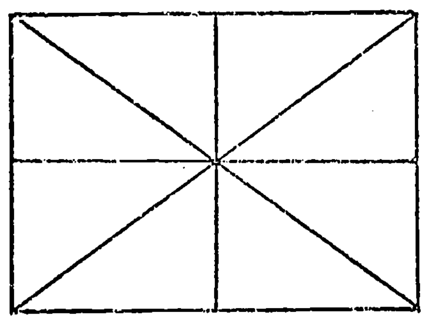

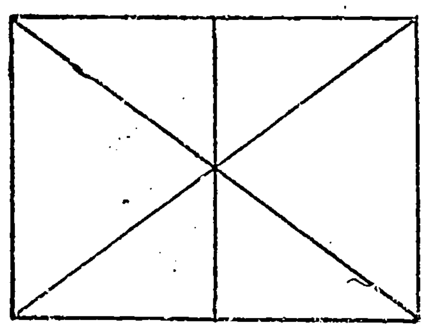

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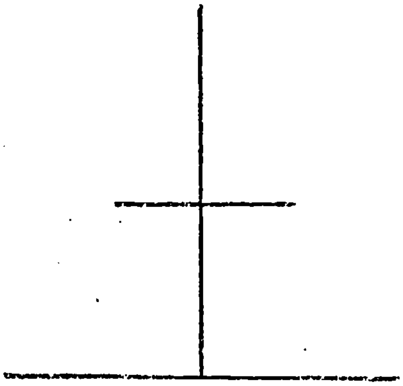

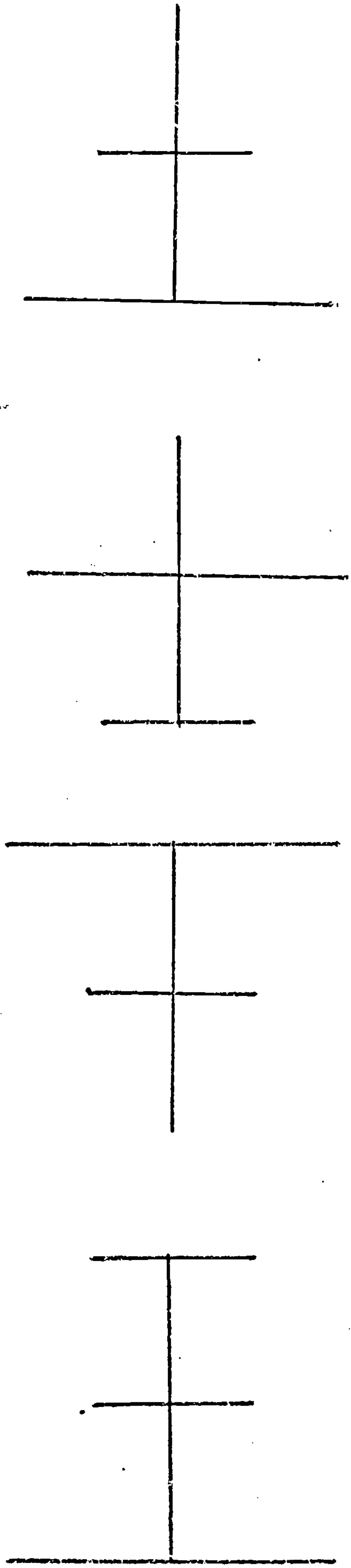

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